NIAGARA FALLS INDUSTRIAL NUMBER

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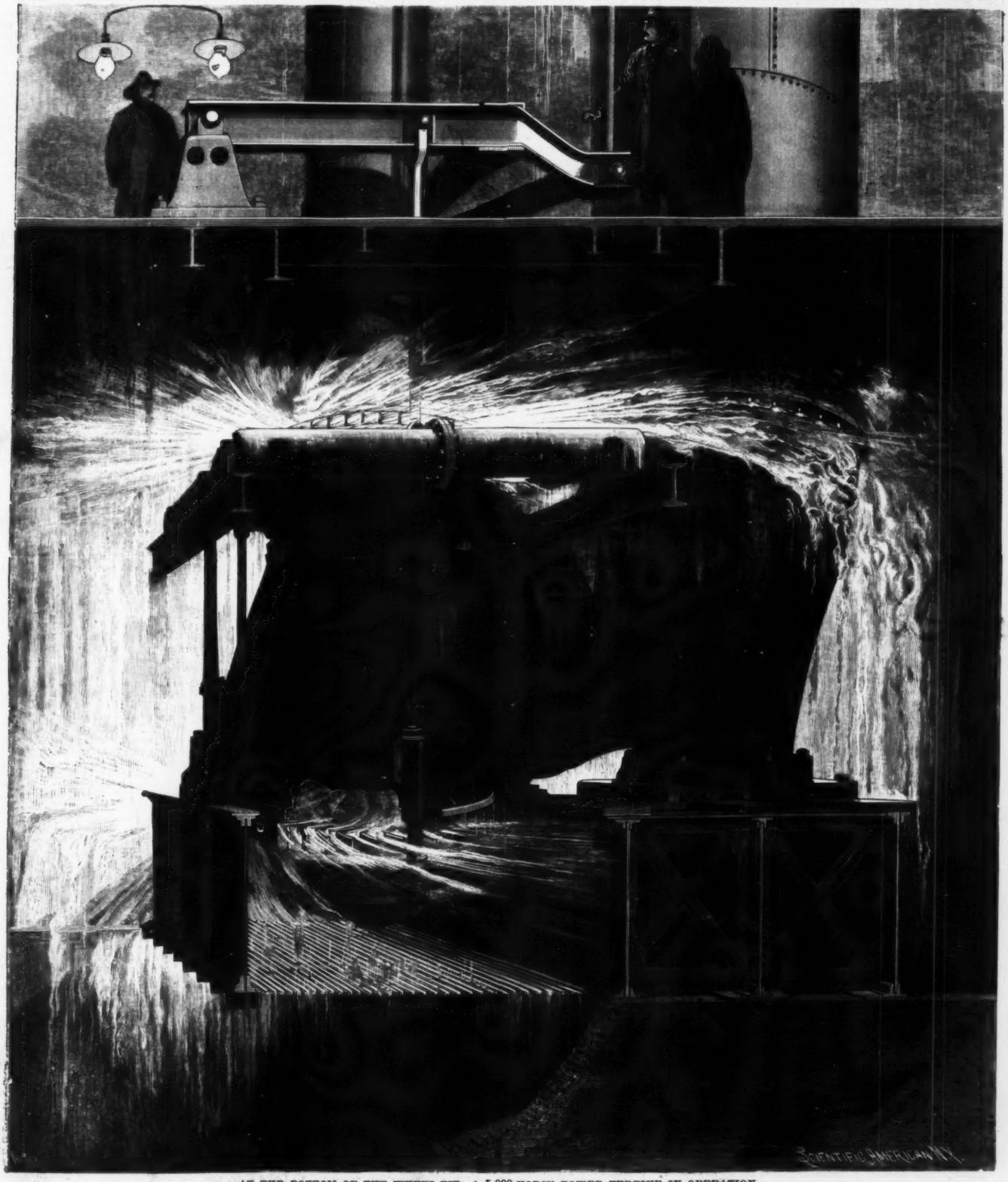


AT THE BOTTOM OF THE WHEEL-PIT—A 5,000-HORSE POWER TURBINE IN OPERATION.

NIAGARA FALLS POWER PLANT.

HISTORICAL.

It is consistent with the utilitarian tendencies of the age that in the closing years of the nineteenth century the stupendous natural phenomena of Niagara should derive no small share of their interest from the industrial and financial possibilities which are contained in the descending waters of the Falls, whose enormous energy is being prodigally expended in producing the matchless scenic effects and ceaseless thunder which we associate with the name "Niagara." For four long centuries men have been content to come and go in this wonderland with no other thought in their minds than of the exquisite beauty and overpowering majesty of it all. But to-day, as the eye ranges from the seething rapids above, down through that sweep of nigh 200 feet to the swirling waters below, the influence of the text-book is upon us, and we instinctively begin to transmute moving waters into multiplied energy, and mentally calculate the millions of horse power that are being squandered in thunder and foam.

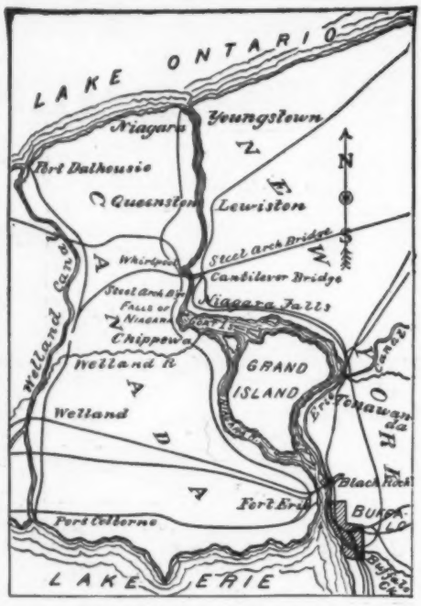
Although the present issue of the SUPPLEMENT is devoted to the industrial development of the Falls, a brief review of the history of the Niagara region will not be untimely. We should naturally expect that this greatest natural wonder on the face of the American continent would have early left its mark both in oral tradition and in written literature, and such is indeed the case. The earliest hint of the existence of the Falls is to be found in Indian tradition, and just how far back this reaches it is impossible to say. The first mention in literature is found in Lescarbot's History of New France, where it is mentioned that Jacques Cartier, during a voyage to the St. Lawrence River, in 1535, was told by the Indians of the existence of a great cataract in the upper reaches of the river, around which it was necessary to pass by a portage. In 1632, Champlain speaks of a lofty waterfall at the end of Lake Ontario, which it is easy to identify with Niagara. One of the Jesuit fathers—those generous contributors in an earlier day to the ascertained geography of the world—in a work published in 1649 makes mention of the discharge of the upper lakes "over a cataract of fearful height," into a lake called Ontario. Later, in 1669, we find René Gallinée, one of the fathers, giving a detailed description of the Niagara Falls which is generally considered to be the earliest published account of the great cataract.

At the foot of the main thoroughfare through the town of Niagara, at a point on the edge of the Gorge midway between the American Falls and the new Electric and Highway Bridge, is shown the spot where the first white man, according to tradition, obtained a view of the majestic waterfall. That was more than two centuries ago, and Father Hennepin was so impressed with what he saw that in his book "Louisiana," published in 1683, he gave the height of the falls as being over three times as great as it actually is, putting it down as 500 feet. Fourteen years later he wrote his quaint work "New Discovery," in which he gives the following oft-quoted description: "Between the lakes Ontario and Erie there is a vast and prodigious cadence of water, which falls down after a surprising and astonishing manner, insomuch that the universe does not offer its parallel." So pronounced is the impression of magnitude upon the mind of the worthy father, that in a later description he adds yet another 100 feet to his former estimate, making the total height of the falls 600 feet. Father Hennepin was the first of a host of word-painters who have attempted to portray the surpassing sight—and failed. Niagara must be seen and heard; moreover, its appeal to the spectator will be as infinitely diverse as there are diverse temperaments in the multitude of pilgrims that gather yearly at its banks from the four corners of the earth.

The whole region of the Niagara River is rich in historic interest. Toward the close of the seventeenth century La Salle landed at the mouth of the river, established a trading-post, and proceeding through the slack waters of the lower river he built a fort where the American town of Lewiston now stands. About ten years later the French erected fortifications at the mouth of the river, extending the work that had been begun by La Salle. The town of Lewiston on the American side, which is the highest navigable point on the river, was formerly the commencement of the portage, which extended to a point about a mile and a half above the falls, or a short distance above the present site of the Niagara Falls Power Plant.

The Niagara region remained in possession of the French for a period of about eighty years, or until the year 1759, when, after a vigorous campaign, the English, by a treaty signed in 1763, secured all the French possessions in this part of the American continent. The memorable events connected with this campaign were the siege of Fort Niagara by the English and the terrible massacre by the Seneca Indians of an English supply train at a point known as the Devil's Hole, about three miles below the falls.

The English remained in undisturbed possession of this territory until the war of the Revolution, when the country adjacent to the banks of the river acquired additional historical interest from the frequent collisions between the English and the revolted colonists. It was destined, however, to become yet more famous during the war of 1812. The first memorable battle occurred when the American army of invasion, crossing at Lewiston, occupied Queenston Heights, but was ultimately defeated by the British under General Brock. The conflict is commemorated by an inscribed stone showing where Brock fell at the foot of the Heights, and by a monumental shaft to his memory at the crest of the Heights. In the year 1813 the Americans were successful in the capture of Fort George, on the Canadian side, an event which so damped the ardor of the English that Fort Erie, at the head of the river, and Chippewa, at the north of the Falls, together with all the military posts along the river, were abandoned. The close of the year was marked by the advance of the English and the blowing up and abandonment of Fort George by the Americans, who, before crossing to Fort Niagara, burnt the village of Newark. This was followed by the surprise and capture of Fort Niagara by the British and the capture and destruction of Lewiston, and Youngstown near Fort Niagara. Later, the enemy pushed on to Buffalo, which was captured and burnt. The tide, however, turned again in the campaign of the following year when Fort Erie surrendered to the American troops on July 3. Two days later the American troops were again successful at the battle of Chippewa. This success led to the retirement of the British to Queenston, with the American troops in hot chase. Three weeks later was fought another engagement at Chippewa, in which the American troops were again successful. Then followed the battle of Niagara Falls, in which the victory was claimed by both armies. The American army then retired to Fort Erie, where they endured a siege which was raised by the American troops in a brilliant sortie that ended in the complete rout of the British. Fort Erie was subsequently blown up and abandoned, and its interesting ruins to-day form one of the favorite haunts of the tourist. The next important historical event was the settlement, in accordance with the terms of peace, of the boundary line between the United States and Canada, which the commissioners determined should run through the center of the deepest channel of the Niagara River, and through the point of the Horseshoe Falls.

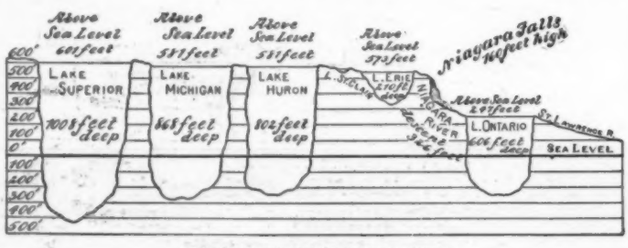


MAP OF THE NIAGARA REGION.

It is now fifteen years since the State of New York wisely determined on the purchase of a suitable amount of land on the American side of the Falls and of Goat Island and the adjacent island, and forming it into a State reservation. Two years later a similar reservation was formed by the Canadian Government, and it is now certain that for the future the natural and historical features of this picturesque region will be carefully preserved from any form of desecration or disfigurement.

GEOLOGY OF THE GREAT LAKES AND NIAGARA.

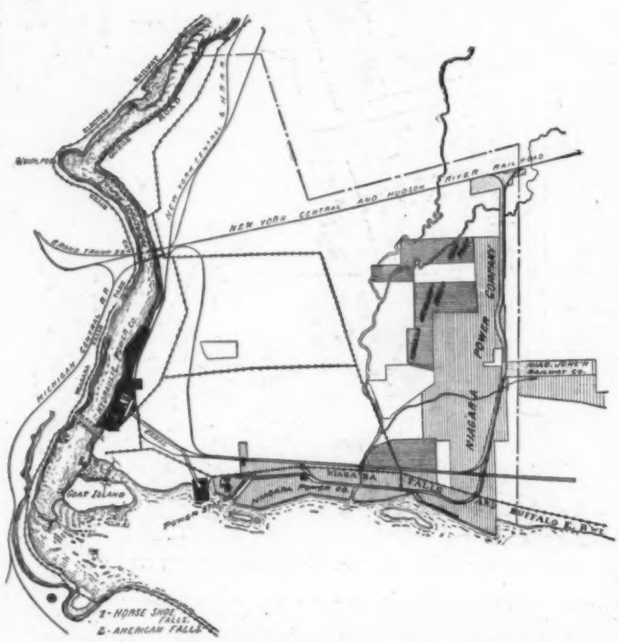
There are few geological problems that have excited more earnest discussion than that of the origin of the Great Lakes and the Niagara River and Falls. Probably the most rational explanation, and the one which is in the most complete agreement with the various geological phenomena, is that which was recently put forward by Dr. Spencer, of the Geological Survey of the Great Lakes. Dr. Spencer is of the opinion that between the middle Miocene and early Pleistocene periods this region stood at an elevation of not less than 3,000 feet, and possibly even 5,000 or 6,000 feet, above the present level. Evidence of this is shown by soundings, taken around the American coast, which show the existence of an ancient river channel. Were the water to sink 600 feet below the present level, the banks to the south of Newfoundland and Nova Scotia would be laid dry, and it would be found that they were traversed by a fjord, whose depth, where it joined the sea, would be over 3,000 feet. It follows for over 800 miles the bed of the present St. Lawrence River, growing narrower and shallower as it projects inland. From the existence of this submarine channel Dr. Spencer supposes that, previous to the existence of the present lake basins, the continent stood at a considerably higher level, and was drained by a great river, to which he gives the name of "Laurentian River." It was this river which served to excavate the deep channel above referred to. Corroborative evidence is found in the fact that the floors of the Great Lakes are from 450 to 250 feet below the present sea level. Soundings of the lakes and borings in various regions reveal the ancient beds of this Laurentian River and its tributaries.



PROFILE OF THE GREAT LAKES.

Around the Great Lakes are found terraces composed of water-worn pebbles, the result of the action of waves or of currents. Examination of these leads to the conclusion that they are of marine origin, and were formed at a time when there was a depression of the surface to over 2,000 feet below its present level. When the depression of the land was greatest, the region of the Great Lakes was a huge ocean gulf, whose shores formed one of the raised beaches surveyed by Dr. Spencer. A close examination of these beaches shows that they do not lie parallel to the present surface of the Great Lakes, but are usually higher above the lake level in the east than in the west, in the north than in the south. This affords evidence of terrestrial deformation having taken place subsequently to the formation of these beaches; and these alterations of the levels have resulted in the formation of the Great Lakes. The first up-lift seems to have taken place in the region to the southwest of the present Lake Huron, and when the land had risen 150 feet, the upper waters of the original gulf, covering Lakes Superior, Michigan, Huron and Georgia, were separated from the lower waters, which extended over the present Lakes Ontario and Erie. This great lake was at first joined to the sea by a broad strait covering the present Lake Nipissing and the Ottawa Valley.

The next event was the isolation of Lake Erie, whose waters at first flowed to the Ontarian gulf without any perceptible fall. The upward movement of the land continued until there was 300 feet of difference between the levels of the gulf and the lake; then it was that the Niagara Falls came into existence. The water flowing over them, however, was only that of Lake Erie, for the overflow of the upper lakes still took place by the Ottawa Valley. The up-lift continued more rapidly in the east than in the west; communication with the sea was gradually closed, save by the present channel of the St. Lawrence, and Lake Ontario was formed. The rising of the land went on, with some short pauses, until the level of the waters ultimately reached 80 feet below the present surface at the mouth of the Niagara gorge, when the Niagara River was about four miles longer than it is now. The Niagara River, which had first been a strait joining Lake Erie to the Ontarian gulf, became a wide, shallow, rapid stream, and then, as the waters of the lower lake subsided, its bed narrowed and its fall increased to 420 feet. The river, however, was soon greatly enlarged. The land was rising to the north of Ontario as well, and ultimately the outlet from Lake Huron to the Ottawa Valley was blocked and the surplus water of the three greatest lakes flowed by their present course to Lake Erie, and thence through the Niagara River. With the continued rise of the land, especially to the east of Ontario, the water level rose until it attained



MAP SHOWING INDUSTRIAL DEVELOPMENTS AT NIAGARA FALLS.

its present elevation, and the fall of the river between the two lakes was reduced to its present height of 326 feet. As to the age of the Niagara River, there is a wide diversity of opinion. Recent writers, using the mean rate of recession of the Falls due to the erosive action of water during the past forty-eight years, as determined by the surveys, would make the age of the falls only 9,000 years. Dr Spencer, however, believes that the Niagara River was formed 32,000 years ago, and that a thousand years later the falls were in existence. As to the future, geologically considered, of the Great Lakes and the Niagara region, the eminent geologist makes a prediction of special interest in connection with the recent opening of the Chicago Drainage Canal and the proposal to open a ship channel from the lakes to the sea by way of the Mississippi basin. He estimates that if the present rate of terrestrial up-lift in the Niagara district and the rate of recession of the Falls continue, before the cataract can have cut its way back to Buffalo, the limestone barrier will have been raised so high as to drain the waters of the upper lakes into the Mississippi basin by way of Chicago. An elevation of 60 feet in the height of Lake Erie would bring the rocky floor of the upper Niagara channel as high as the Chicago divide, and an elevation of 70 feet would completely divert the drainage. The date of this event, which is merely a geological possibility, is yet some 5,000 or 6,000 years removed.

A BIRD'S-EYE VIEW OF NIAGARA.

FOR the benefit of those readers who have never been so fortunate to visit Niagara we have prepared a bird's-eye view of the Niagara region which shows at a glance the striking topography of the Falls and the Gorge, the various handsome bridges which span the latter, and the location of the two great hydraulic-electric stations in which a small portion of the energy of the Falls is being developed for industrial use.

By reference to the accompanying map, it will be seen that the Niagara Falls are situated on the river of that name and about midway between Lake Erie and Lake Ontario. The river, which is 33 miles in length,

A BIRD'S-EYE VIEW OF NIAGARA FALLS, LOOKING NORTHEAST TO LAKE ONTARIO.

flows in a general northerly direction, and in that distance it has a total fall of 326 feet, most of which occurs in the last 17 miles of its course. It forms the channel by which the whole of the drainage of the four great lakes, Superior, Michigan, Huron and Erie, flows into Lake Ontario; and as the total drainage area is 90,000 square miles and the total flow 275,000 cubic feet per second, it can be understood that Niagara is a truly imposing river. The interruption to navigation presented by the falls and rapids has been overcome by two notable canals. On the Canadian side, the Welland Canal has been cut in a northerly direction from Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario (see map), and communication with tidewater on the American side is maintained by the Erie Canal, which extends from Buffalo, at the entrance to the Niagara River, to Cohoes, on the Hudson River. The Canadian Canal forms part of an extensive system which provides an outlet from the great lakes by way of the St. Lawrence River. It has recently been completed; and it is now possible for vessels drawing 14 feet of water to proceed from the Lakes to deep water at Montreal, where cargoes can be transferred to ocean steamers. It is proposed to deepen the Erie Canal to allow the passage of vessels of 12 feet draught, capable of carrying 1,000 tons of freight. An article illustrative of these two enterprises will be found in the SUPPLEMENT of February 10, 1900.

After leaving Lake Erie, the river flows somewhat swiftly for the first two miles, and then, with a slackening and widening current, divides to pass on either side of Grand Island (see map), below which it widens to its fullest breadth of two and one-half to three miles, and flows sluggishly among the numerous low-lying islands that make it look more like a lake than a river. Here the general course of the river is westerly, and it gradually narrows as it approaches the Upper Rapids, which extend about a mile above the Falls. At this point the river enters the field of the bird's-eye view embraced in our engraving. The total fall of the rapids is 52 feet, and, as the extreme width of the river is here 4,750 feet, the swift rush of the expanse of troubled water over its rocky bed forms a fitting introduction to the stupendous falls below. About half a mile from the brink of the Gorge the river is divided by Goat Island into two unequal streams, the one on the American side comparatively shallow and narrow, discharging over the precipice in what is known as the American Falls, while the major portion of the river swings around to the north and discharges over a crest

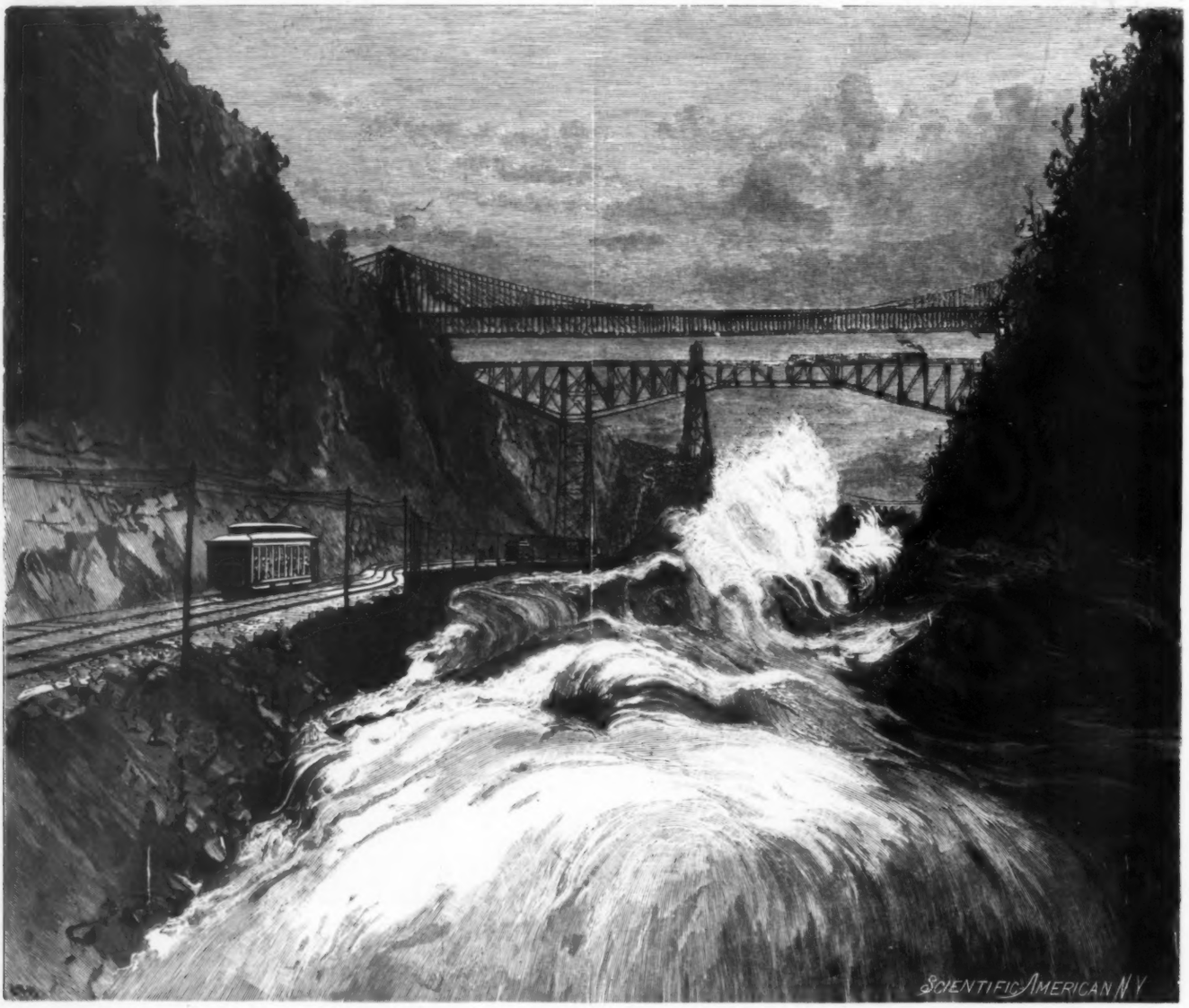
LEWISTON BRIDGE—ONE OF THE ANCHORAGES.

of a general horseshoe form, from which it takes its name.

The American Falls are 1,060 feet in width, with an estimated maximum depth at the crest of 8 feet, and a vertical fall of 167 feet. The Horseshoe or Canadian Falls have a total width of 3,010 feet, a maximum estimated depth of 20 feet, and the vertical height is 158 feet. It is a singular fact that the amount of water which passes over the Falls is practically constant, and what variations there are, are not caused by rainfall, snow, or changes of temperature, but are dependent upon the prevailing winds, which, if they blow strongly and alternately from certain opposite quarters, back up and then release the waters of Lake Erie and greatly increase the depth of the water at the Falls for the time being. The normal flow, according to the gagings of the United States engineers, is 275,000 cubic feet per second, or about half a million tons per minute. The total fall available for power purposes from the commencement of the Upper Rapids, where the power companies have their intakes, to the river immediately below the falls is 216 feet, and this shows the theoretical horse power of the Falls to be about 6,750,000. If we include the additional fall of 100 feet from the foot of the Falls to Lewiston, 8 miles below, we find that the theoretical possibilities of Niagara must be put down at 10,000,000 horse power.

There is no great depth of water underneath the American Falls, indications being that its bed is full of massive and broken rock; but the enormous mass of water (estimated at from four-fifths to nine-tenths of the whole) that thunders over the Horseshoe Falls with a depth at the center of 20 feet, has excavated a basin and channel that is fully as deep as the Falls themselves. The river maintains this depth, from shore to shore, for a mile and a half or more below the Falls, shallowing gradually as it approaches the cantilever bridge of the Michigan Central Railroad. The enlarged cross section of the channel has the result of slackening the stream, so that it flows very sluggishly through this part of its course, so much so that small rowboats do not hesitate to cross from shore to shore. At the new steel arch railway bridge the river begins to fall with great rapidity over an extremely rocky and uneven bed, the fall extending for about a mile. As the Gorge at this point narrows considerably, the confined waters rush down tumultuously at an estimated speed of 30 miles an hour, and the effect, as one stands at the bottom of the Gorge and close to the edge of the mighty torrent, is even more inspiring than that of the Falls themselves. The "10,000,000 horse power," the "30,000,000 tons per hour," and other figures of Niagara seem very conservative when one is standing on the edge of the Whirlpool Rapids.

At the foot of the Rapids is the Whirlpool, where the river takes a sudden turn of about 90 degrees to the right. The onslaught of the river against the opposing cliffs, assisted by a natural depression, has worn out a vast circular basin into which the waters of the rapids rush, and form the celebrated Whirlpool. From



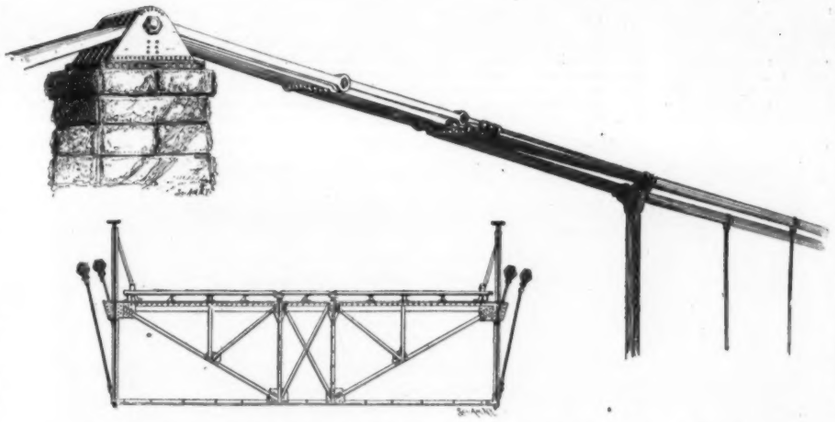
VIEW OF THE WHIRLPOOL RAPIDS, SHOWING THE OLD SUSPENSION BRIDGE PRIOR TO THE ERECTION OF THE NEW RAILWAY ARCH BRIDGE.

ELECTRIC RAILWAY THROUGH NIAGARA GORGE.

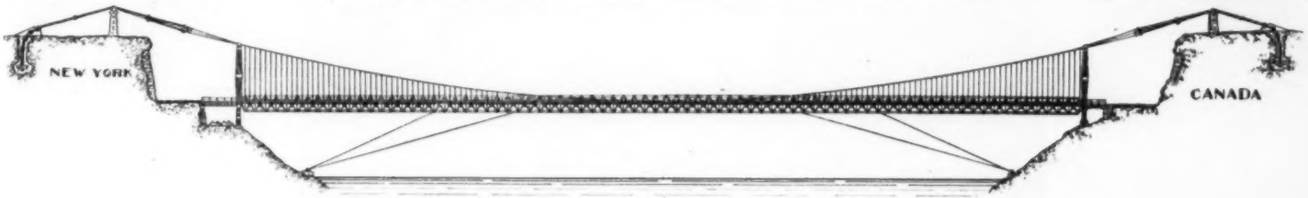
the Whirlpool the river flows through a broadening and less precipitous channel, until it passes between the picturesque towns of Lewiston and Queenston, to broaden into a wide channel for the rest of its journey to Lake Ontario. The fall in this last seven miles of the river is about half a foot to the mile.

By studying the bird's-eye view of Niagara, our readers will see that the river appears to have cut its way back from Lewiston through an elevated and generally level country, and this impression is confirmed by a study of the actual locality. Coming up the river from Lake Ontario, one notices that the surrounding country is low and fairly level, but at Lewiston there is a lofty and somewhat precipitous escarpment or bluff, the ground rising to a height of 374 feet above the lake level. This high level is maintained with slight undulations up to the Falls. The indications, as we have shown in the previous chapter, are that the latter were originally located at Lewiston and Queenston, and have in the course of ages cut their way back to their present position. The depth from the crest of the Gorge to the river varies from 200 to 300 feet, and its width varies from 1,500 feet at the Falls to 220 feet at the lower end of the Whirlpool Rapids.

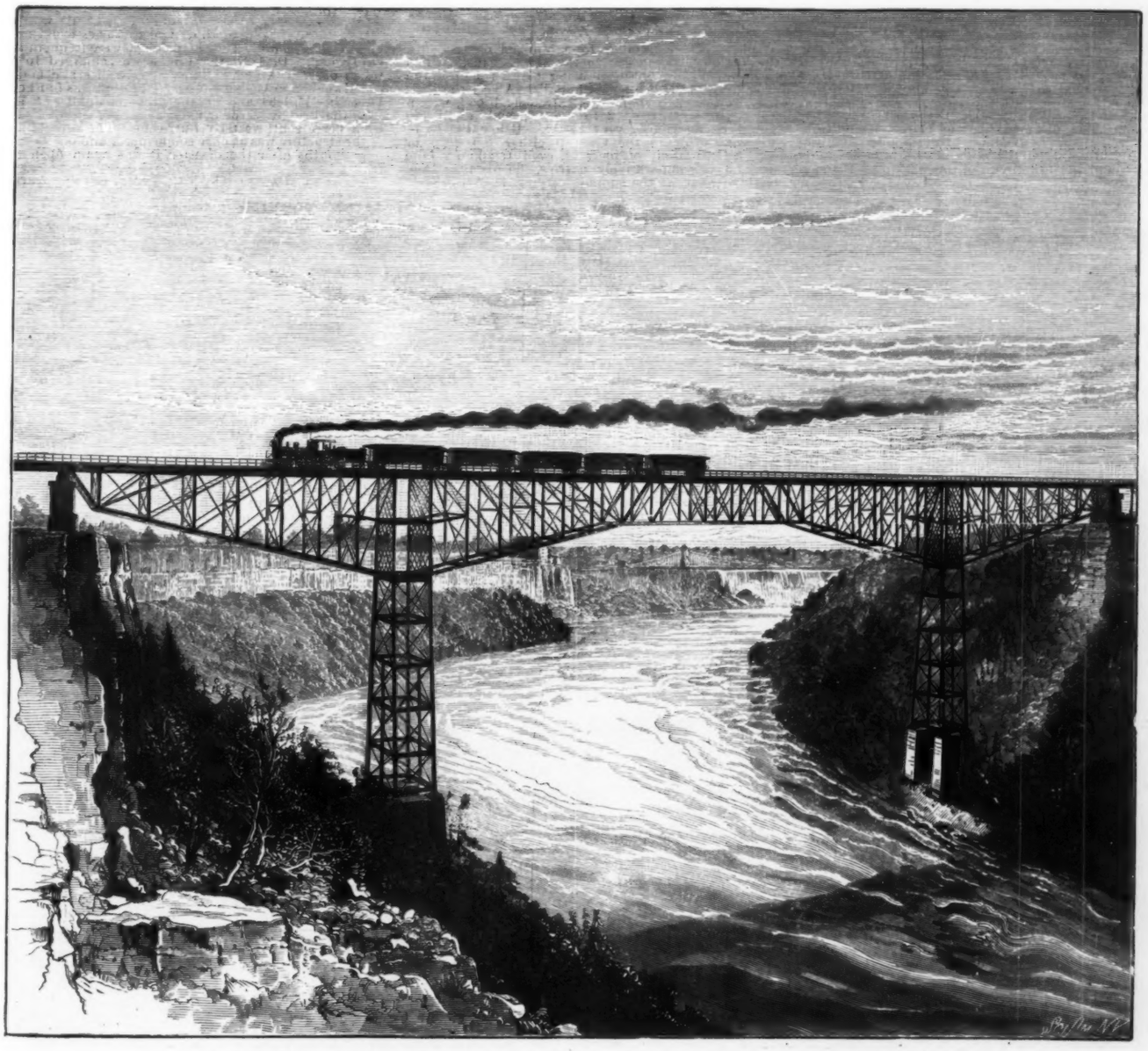
The construction of the magnificent steel arch bridge just below the Falls, and the recently opened suspension bridge from Lewiston to Queenston, has rendered it possible to make the entire circuit of the Niagara Gorge by rail. The two scenic railways, one on the American and the other on the Canadian side, afford exceptional opportunities for viewing the natural beauties of the river,



LEWISTON BRIDGE—TOWER, CABLES, AND CROSS-SECTION THROUGH FLOOR SYSTEM.



LEWISTON SUSPENSION BRIDGE—LENGTH BETWEEN TOWERS, 1,040 FEET; LENGTH OF STIFFENING TRUSS, 800 FEET.



LENGTH OF SHORE ARMS, 195 FEET 2 INCHES; LENGTH OF MAIN SPAN BETWEEN TOWERS, 470 FEET.

THE CANTILEVER RAILROAD BRIDGE ACROSS NIAGARA GORGE, VIEWED FROM RAILROAD SUSPENSION BRIDGE.

one of them running at the very edge of the boiling waters and threading its tortuous way around the base of the precipitous cliff, while the other on the opposite side of the river follows the irregular indentations of the Gorge, and allows the traveler to look down upon Niagara from cliffs that rise a sheer 300 feet above its troubled flood. The electric road on the American side, which is known as the Gorge Road, starts from the lofty Observation Tower near the American end of the steel arch highway bridge and runs through the streets and out into the country, until a point about a half mile above the Cantilever Bridge on the edge of the cliffs is reached. Here the descent begins, and with a maximum grade of three per cent, the track runs down the sides of the cliff toward the great rapids. The lower level is reached a short distance below the Cantilever Bridge, and thence the road winds along the foot of the cliffs twenty feet above the usual water level.

Our illustration shows the scene at the rapids near the point where the river level of the road begins. Hence the rapids are in their wildest commotion. The great volume of water which has come over the Falls is crowded with great velocity through a channel of decreased cross-section. Here the water in the center of the rapids sometimes boils up until its crest is 30 feet higher than the water level at the banks. A very curious feature is the formation and maintenance of almost stationary waves, a mass of water at times lifting into a smooth, crestless wave whose contour will be permanent for minutes at a time. In the illustration the long descent of the road is shown, and the car is seen entering upon its course through the Gorge. At Lewiston connection is made over the new Suspension Bridge with Queenston on the Canadian side, where the line of the Niagara Falls, Park and River Electric Railway begins its climb around the base of the Queenston Heights to the superb prospect that opens from their summit. The distance by the Gorge Road, from Niagara Falls to Lewiston, is about 7 miles, and the return journey upon the edge of the opposite cliffs and around the full circuit of the Whirlpool is somewhat greater.

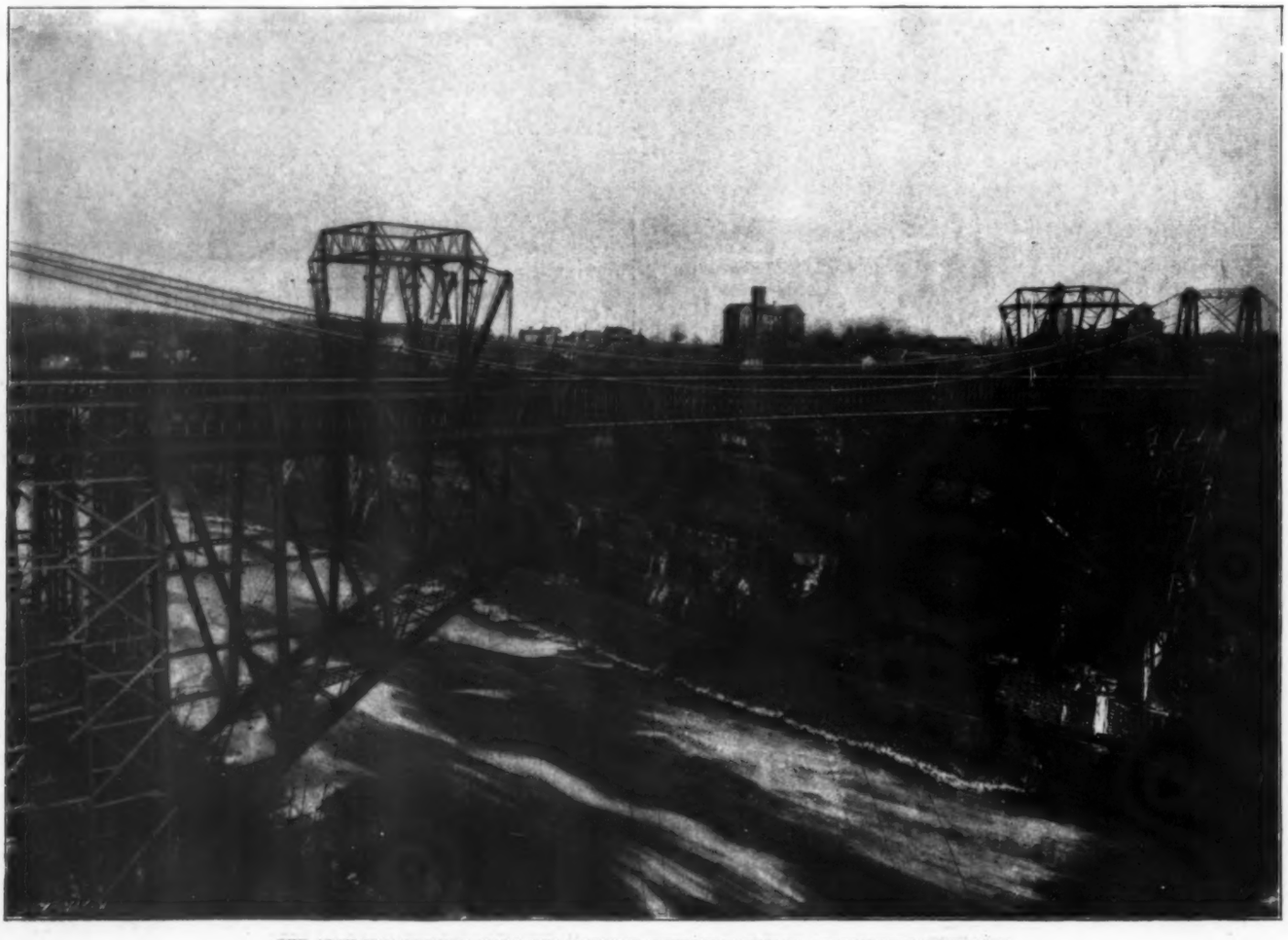
THE BRIDGES OF NIAGARA GORGE.

BY no means the least interesting feature of Niagara Falls and that stretch of the river whose scenic features have assisted to make this locality world-famous, is the number of picturesque bridges which span the Gorge, and form important links between the American and Canadian shores. A brief glance at the engravings which show the peculiar topographical character of the region is sufficient to reveal the causes which have led to the bridges being thrown across the river below and not above the Falls. Above the Falls the river, though shallow, is extremely broad, widening in places to from 2 to 3 miles, and a crossing would be necessarily very costly. Below the Falls, however, although the river is either too deep or too swift to admit of piers or even temporary false work, it is comparatively narrow, the distance from bank to bank at the summit varying from 1,200 feet just below the falls to 700 or 800 feet at the railroad bridges a mile further down the river. By reference to the bird's-eye view of Niagara, it will be seen that there are at present four bridges across the river. The first is the great steel-arch structure, known locally as the Upper Bridge, and again as the Niagara Falls and Clifton Bridge, which spans the river with a single arch, 840 feet between abutments, at a point about a quarter of a mile below the American Falls. A mile below is the cantilever bridge which carries the tracks of the Michigan Central Railroad, while closely adjoining it is the handsome Railway Arch Bridge recently opened, which was built to replace the old railroad suspension bridge which stood on the same site. A few miles further down the Gorge, at Lewiston and Queenston, is the suspension bridge which takes the place of the wrecked structure of an earlier bridge, the cables of which have for many years been a familiar feature at this point on the river.

VIEW DOWN THE RAPIDS BENEATH THE CANTILEVER AND RAILWAY ARCH BRIDGES.

NIAGARA FALLS AND CLIFTON SUSPENSION BRIDGE.—Although it is true that there are but four bridges at present in existence, no less than nine separate bridges have been built at Niagara at different times during the past fifty years, the earlier structures having been either destroyed by wind-storms or rendered obsolete by the advance of engineering and the growing demands of traffic. The first bridge to be erected at the site of the new Niagara Falls and Clifton structure was a suspension bridge of wood and iron, opened January 2, 1869, whose span was over 1,200 feet. The cables were of iron wire, the towers and the roadway of wood. It was only 10 feet in width, and, as two carriages could not pass each other upon it, long delays were frequent at either end. In 1887, the bridge was enlarged to a width of 17 feet, new 2½-inch steel cables and additional anchorages being added. The work was finished December 15, 1888, and on the night of January 9–10, 1889, the bridge, scarce a month old, was swept away by a fierce southwesterly hurricane. The rebuilding of the structure was at once commenced, and on May 7, four months after the disaster, it was again open to traffic.

NIAGARA FALLS AND CLIFTON STEEL ARCH

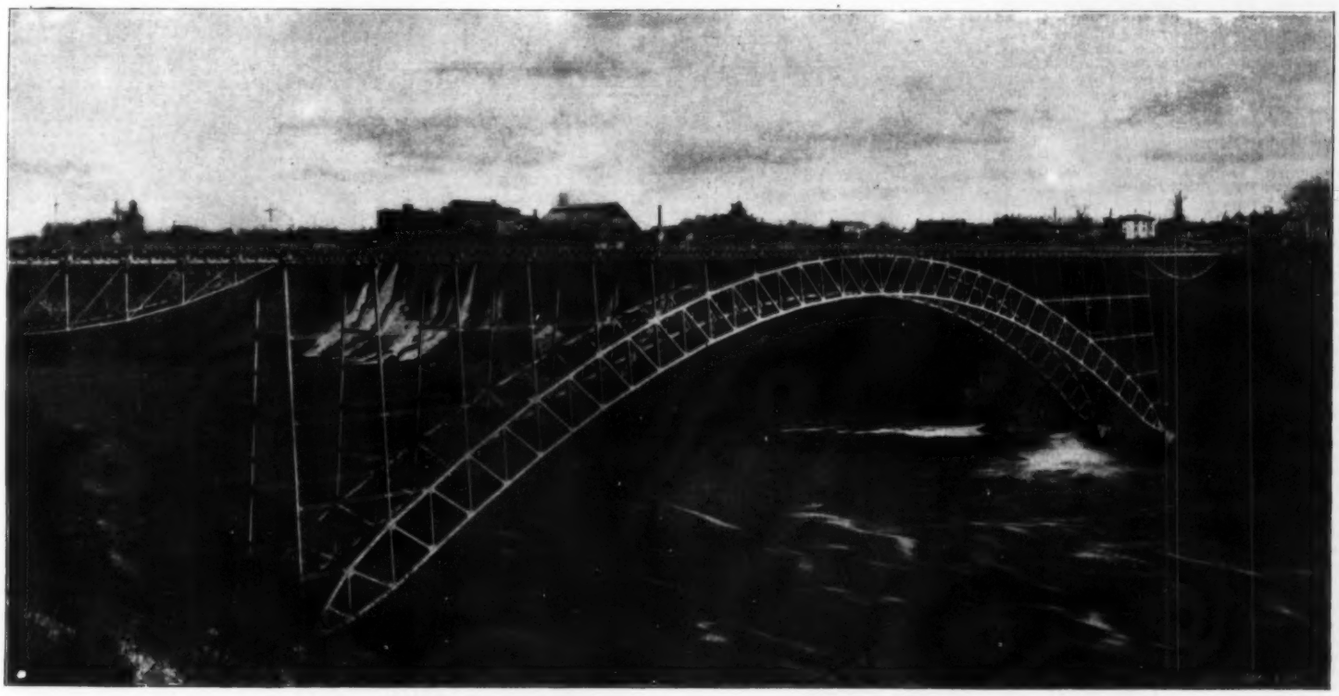


THE ARCH WAS ERECTED FROM THE RAILWAY SUSPENSION BRIDGE, SUBSEQUENTLY REMOVED.

ERECTION OF THE 550-FOOT RAILWAY ARCH BRIDGE.

BRIDGE.—The development of the electric railways on each side of the gorge and the evident advantages of making a connection at each end, and so forming a continuous belt line, led to the erection of the present magnificent arch bridge, opened in 1898, whose span of 840 feet far exceeds that of any other arch bridge in the world, the next longest being the center span of the highway bridge at Bonn, Germany, which measures 639½ feet in length. The total length of the bridge is 1,240 feet and the rise 150 feet, the main span being supplemented by two shore spans, one 190 feet and the other 210 feet in length, which serve to carry the superstructure to a connection with the top of the cliffs. The masonry abutments of the main span are built at the edge of the river banks, the distance laterally between centers of the abutments being 68 feet 9 inches. The two trusses have an inward batter at the rate of 1¾ in 12, and the posts of the supporting bents which carry the roadway lie in the same plane. The bents rest upon the alternate panel-points of the trusses and they are strongly braced against longitudinal and lateral distortion. The roadway, 49 feet in width, provides two electric tracks, two driveways, and two footwalks for passengers. The shore spans are inverted bowstring trusses of graceful proportions. It is scarcely possible to speak in too high praise of the beauty and general engineering merit of this structure, and great credit is due to Mr. L. L. Buck and his assistants for having treated this formidable problem with such excellent æsthetic results that the new structure rather adds than detracts from the scenic effects at this part of the Gorge. In our illustrations of the bridge the point of view is on the Canadian shore looking northeast toward the Hydraulic Power Company's plant, just beyond which is seen the cascades formed by the tailraces of various smaller factories. The outlet of the 7,000-foot tunnel, which discharges the water from the Niagara Power Company's plant, is seen just below the downstream abutment of the bridge.

CANTILEVER RAILROAD BRIDGE.—It is not necessary to give any lengthy description of the Cantilever Railroad Bridge, a mile below the arch—so well is it known to the public. It was built in 1883 from the designs of Mr. C. C. Schneider and opened in December of that year. The crossing is about 100 yards above the site

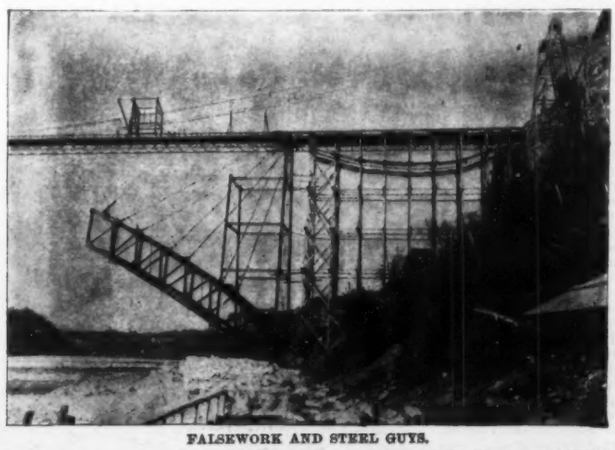


LENGTH OF MAIN ARCH BETWEEN ABUTMENTS, 840 FEET; RISE, 150 FEET; LENGTH OF SHORE SPANS, 190 AND 210 FEET.

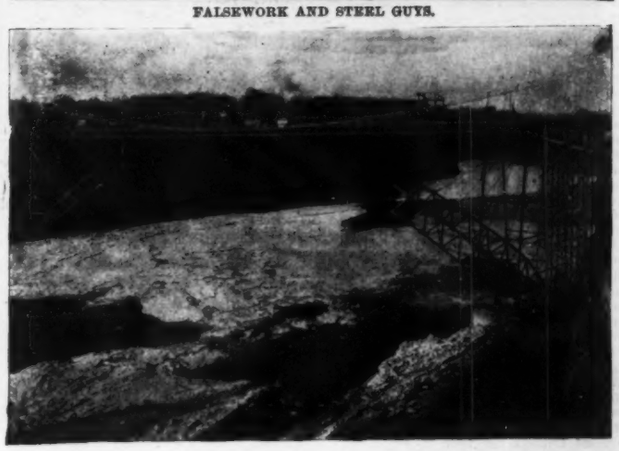
NIAGARA FALLS AND CLIFTON ARCH BRIDGE.

BUILT, 1851; WRECKED BY WIND, 1864; REMOVED, 1898.

WRECK OF THE OLD LEWISTON SUSPENSION BRIDGE.



FALSEWORK AND STEEL GUYS.



ERECTING THE ARCH FROM THE OLD HIGHWAY SUSPENSION BRIDGE.

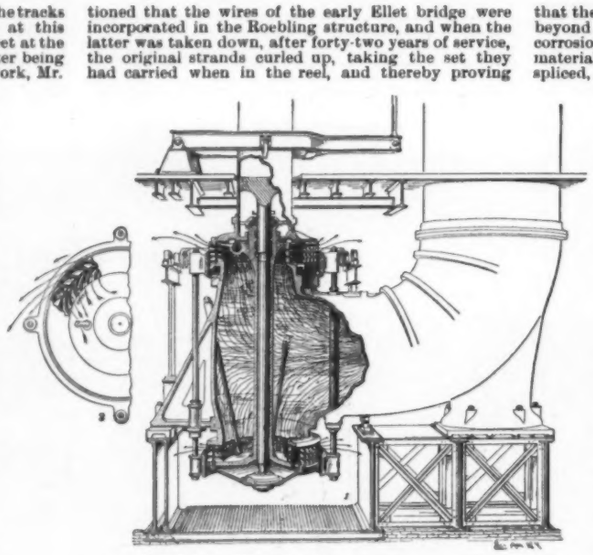
NIAGARA FALLS AND CLIFTON ARCH BRIDGE.

of the new Railway Arch Bridge, which carries the tracks of the Grand Trunk Railroad. The Gorge at this point is 850 feet in width at the crest and 425 feet at the river edge, the depth to the surface of the water being 210 feet. As it was impossible to use false-work, Mr. Schneider designed a cantilever bridge, with towers, located at the foot of the sloping cliffs, and built out the main span by overhang—a method he had already carried through successfully at the Frazer River on the line of the Canadian Pacific Railway. The structure, which carries a double track, consists of two cantilevers resting on the towers, and a central suspended truss. The shore arms of the cantilevers are 195 feet 2 inches and the river arms 175 feet in length, while the supported span is 119 feet 10 inches long, the total clear span between the towers being 470 feet, and the total length of the bridge between the anchorages on the edge of each cliff is a few inches over 910 feet. Although later developments in cantilever construction have rendered the Niagara Bridge insignificant in comparison, the spans of the Forth Bridge, for instance, being 1,710 feet, the Niagara cantilever will always be notable as being one of the earliest successful applications of the cantilever system of construction. The structure carries a double track, and it was designed for a rolling load consisting of two 66-ton locomotives followed by a trainload of 2,000 pounds to the lineal foot.

This was ample in 1883, but now, after a lapse of sixteen years, we have locomotives on some American roads weighing, with tender, as much as 167 tons, and trains that will average 4,000 pounds rolling load to the foot. To meet the changed conditions the Michigan Central Railroad is now strengthening the whole structure in an ingenious and novel manner. A new truss equal in strength to the other two is to be built through the center of the structure from shore to shore, new bents and masonry foundations being erected in the center of the towers. The reconstructed bridge is to have an increased carrying power of 50 per cent.

RAILWAY SUSPENSION BRIDGE.—The adjoining bridge site, 300 feet down stream, is of special interest, exceeding in this respect any other across the gorge. Here, in 1848, was erected the first bridge to span the then formidable chasm. It was a crude affair, though creditable to its designer, Mr. Charles Ellet, if we consider the early date and the lack of appliances. The floor, which was only 7½ feet in width, was not provided with any stiffening truss. In 1853, this structure gave place to the famous Railway Suspension Bridge designed by Mr. John A. Roebling, in which the theories of the strength of materials and the strains in framed and suspended structures received a more thorough application than had ever before been attempted in this country. It required all the courage of Mr. Roebling's convictions to erect a suspension bridge for carrying railroad trains at a time when opinion inclined to the more rigid systems for this class of bridge; but the structure, although it has now been replaced by a steel arch, proved to be fully adequate to its duties for several decades of very severe work. The span measured 821 feet 4 inches between towers. It was carried on four 10-inch cables of iron wire, and the floor system was double-decked, the upper deck carrying a single railroad track and the lower being used for common travel. It was stiffened by two timber trusses, 18 feet in depth, the trusses being built on the Pratt system.

It should be mentioned that the wires of the early Ellet bridge were incorporated in the Roebling structure, and when the latter was taken down, after forty-two years of service, the original strands curled up, taking the set they had carried when in the reel, and thereby proving that the cables, at any rate, had never been strained beyond their elastic limit. In 1877, it was found that corrosion of the wires had taken place; the defective material was taken out, other wires inserted and spliced, and at the same time the wooden truss was replaced by one of iron. In 1886, the stone towers showed such signs of deterioration that it was decided to replace them with new towers of steel. This difficult task was accomplished by Mr. L. L. Buck, who also was responsible for the repairs of 1877, without any interference with the traffic.



SECTIONAL VIEWS OF A 5,000-HORSE POWER TURBINE.

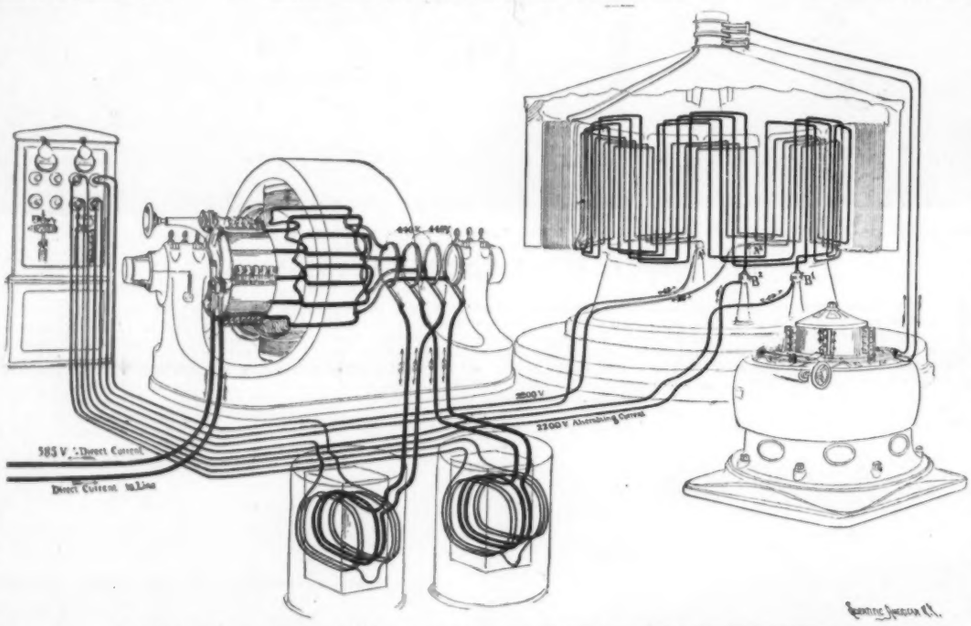
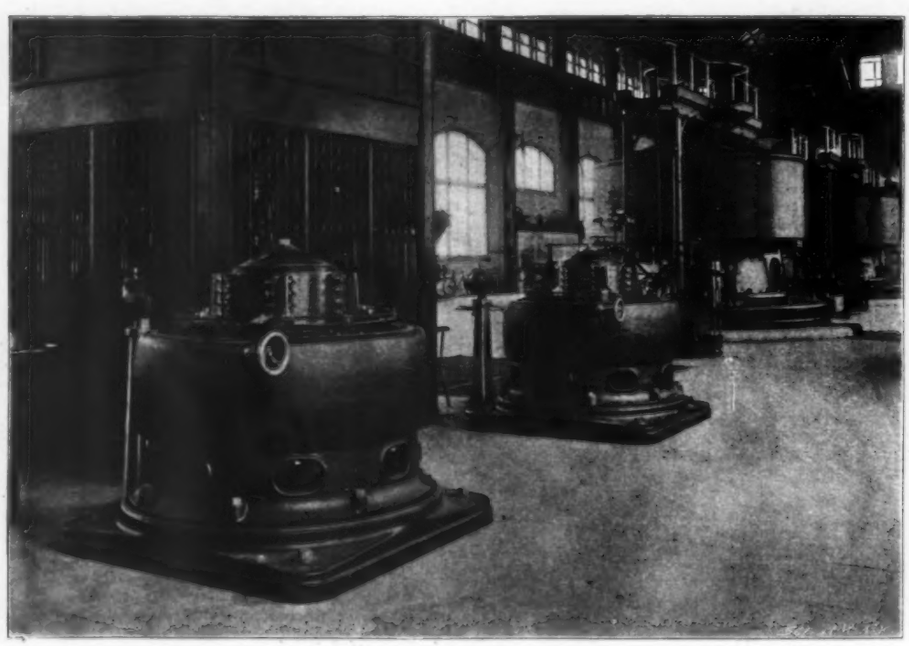


DIAGRAM OF WIRING OF MAIN GENERATORS AND STATIC AND ROTARY TRANSFORMERS.



GENERATORS FOR EXCITING FIELDS OF MAIN 5,000-HORSE POWER GENERATORS.

THE NIAGARA RAILWAY ARCH, as it is called, is a two-hinged, spandrel-braced arch of 550 feet span and 114 feet rise. The masonry abutments are located about half way down the slope of the gorge, upon a solid stratum of gray limestone, and the main arch is flanked by two connecting shore spans, 115 feet in length, which carry the floor system from the arch to the edge of the adjoining cliffs. The structure is double-decked, the upper deck carrying two tracks and the lower providing a roadway with broad sidewalks carried on the outside of the trusses. The bridge is proportioned for a live load on each of the tracks of two 128 ton engines, followed by a train load of 3,500 pounds to the foot, besides the live load due to travel on the road and footways on the lower deck. The bridge was erected by building the shore trusses upon false work, tying them back to anchorages on the shore and then building out the main arch by overhang, as shown in our first-page engraving. The material was brought out upon the suspension bridge and handled by travelers which ran upon the top chords of the arch trusses. The new bridge was built and the old bridge removed without any interruption of the traffic—a result which is greatly to the credit of Mr. Buck and his assistant, Mr. Richard S. Buck, the resident engineer in charge of construction at the site.

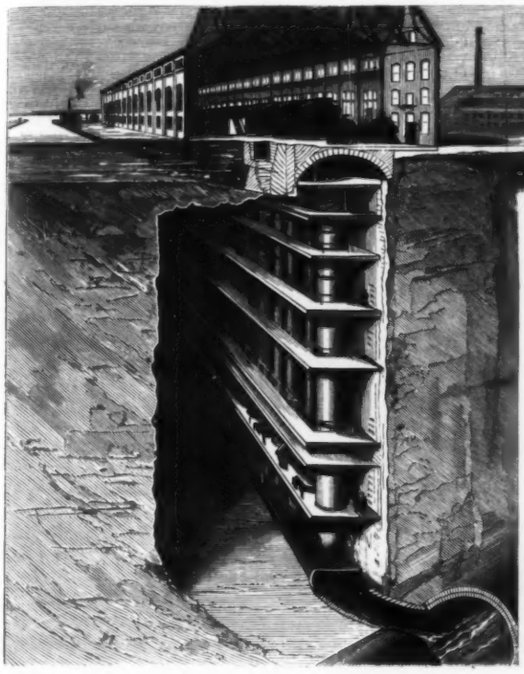
THE LEWISTON SUSPENSION BRIDGE stands upon the site of an earlier structure—the old Lewiston Suspension Bridge, which was built in 1851-52 and destroyed by a windstorm on the morning of February 1, 1864. The new bridge connects the southern termini of the Gorge Railroad (electric) which follows the cliff and shore line of the river from Niagara to Lewiston, on the American side, and the Niagara Falls Park and River Electric Railway, which runs near the edge of the cliff from above the falls to Queenston on the Canadian side. The general appearance of the bridge can be judged from the accompanying drawing, and the principal dimensions are as follows: Distance from tower to tower, 1,040 feet; span of stiffening truss, 800 feet; width, 28 feet; width of roadway, 25 feet. The bridge carries a single electric track with a roadway on each side of it; but no special provision is made for the foot-passenger traffic which will be very limited. The connecting span on the New York side will be 34½ feet long and that on the Canadian side 19½ feet. Much of the masonry of the towers came out of the towers of the old bridge. There are four cables, each consisting of fourteen 2½-inch steel wire ropes, the ropes being those which formerly carried the Upper Suspension Bridge near the Falls, already described. They were long enough to allow of their being cut in half and used in the new bridge, and to piece out the necessary span between towers, 75 feet at the end of each cable is made up of eye-bars. The cables are continued in the eye-bar form from the towers down to the anchor-

THE NIAGARA FALLS 50,000-H. P. POWER PLANT

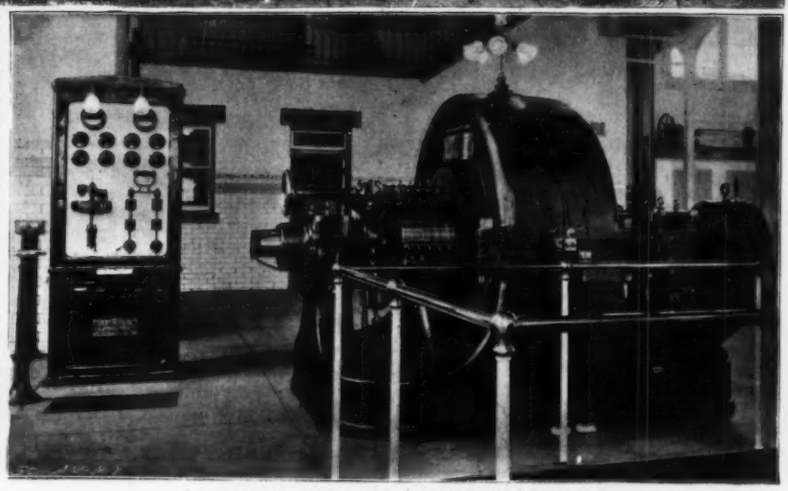
ages, 150 feet back from the edge of the cliffs. Here the eyebars are carried into a shaft, at the bottom of which they are connected to anchor plates, the excavation being filled up with concrete. A view of the top of an anchorage is shown in the accompanying cut. At each of the points where the suspended structure

PRESENT STATUS OF THE INDUSTRIAL DEVELOPMENT OF THE FALLS.

EVER since the year 1725, when a small sawmill was erected at the Falls, their vast store of energy has appealed to the mechanical instincts of man and invited his co-operation; but it is only of late years that any serious attempt has been made to utilize this energy on an extensive scale. By far the largest modern plant is that of the Niagara Falls Power Company, whose canal and power house are situated about a mile above the American Falls, and therefore above the Upper Rapids. The water is led in from the river by a canal of sufficient capacity to deliver water for the generation of 100,000 horse power. At the side of the canal is a huge wheel-pit, to the bottom of which the water is led by eight large penstocks. At the base of each penstock is a 5,000-horse power vertical turbine. Each main shaft carries at its upper end within the power house a 5,000-horse power generator, the total capacity of the plant, as now established, being 50,000 horse power. Another power house of equal capacity is shortly to be built on the opposite side of the canal, and the company has franchises which



SECTIONAL VIEW OF POWER HOUSE, WHEEL-PIT AND TAILRACE TUNNEL.



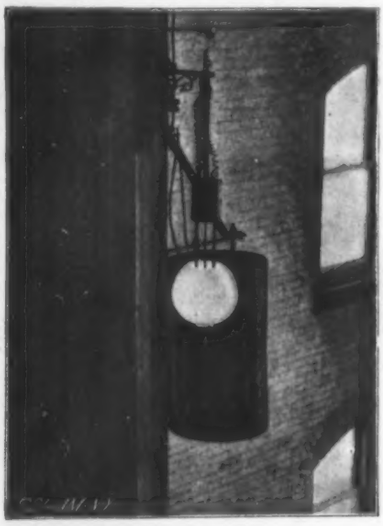
ROTARY TRANSFORMER FOR LOCAL RAILWAY SUPPLY.

INTERIOR OF POWER HOUSE WITH TEN 5,000-HORSE POWER GENERATORS INSTALLED.

THE NIAGARA FALLS 50,000-H. P. POWER PLANT.

connects with the short flanking spans a rocker bent is introduced which rests on a shoe below and extends up to the cables above. The bent is hinged at the shoe, at the end of the truss, and at the cable. This construction, and indeed the whole bridge, is novel and not by any means lacking in picturesque effect.

will allow it to erect a 250,000-horse power plant on the Canadian side whenever it is prepared to do so. The tailrace of the present power house is carried through a tunnel 7,000 feet in length, which was driven from the bottom of the wheel-pit in a straight line beneath the town of Niagara Falls to an outlet at the base of the cliffs just below the abutments of the Upper Arch Bridge. The location of this tunnel is seen in the accompanying sectional view where its course is shown from the power house to the river. The outlet is also marked on the bird's-eye view on page 20209. The Niagara Falls Paper Company, whose works adjoin the power house of the Niagara Falls Power Company, utilize 7,200 hydraulic horse power, taking



AN ELECTRIC HEATER IN THE POWER HOUSE.

the water from the canal and discharging by their own tailrace into the tunnel.

Next in importance is the Niagara Falls Hydraulic Power and Manufacturing Company. It owns a canal, shown on our engraving, which leaves the river at a point above the rapids and 2,000 feet below the canal of the Niagara Power Company, and runs through the town to a basin situated near the edge of the gorge and a quarter of a mile below the Upper Bridge. Here the water is led by two penstocks, one 8 feet and the other 13 feet in diameter, to a power house situated 200 feet below at the edge of the river, where its energy is developed in a series of horizontal turbines. The present installation represents a capacity of 22,000 horse power, and this is to be increased shortly to about 35,000 horse power. By extending the terminal basin northward along the cliffs, enlarging the canal and building another power house at the river level, below the present small users of the canal water, it is proposed to develop 100,000 horse power. The franchise allows the company to develop 125,000 horse power from the river.

The canal, which was built in 1858, also supplies a number of industrial works which utilize only a part of the available head of 210 feet. Most of these turbines operate under a head of from 60 to 100 feet, and about 7,500 horse power is developed in this way. The tailrace discharges are through short tunnels or through open cuts in the face of the cliff, and the foaming cascades thus formed (see illustration on page 20220), constitute one of the beautiful effects on the American side of the Gorge.

On the Canadian side, the Niagara Falls Park and River Railway has a power house opposite the Horseshoe Falls in which are two turbines working under a 68-foot head, with a combined capacity of 2,000 horse power.

Including then all the various users of the Niagara River waters for power purposes, we find that at the present writing, of the total theoretical horse power of 7,500,000, not more than 75,000 horse power is being actually developed and turned to useful account.

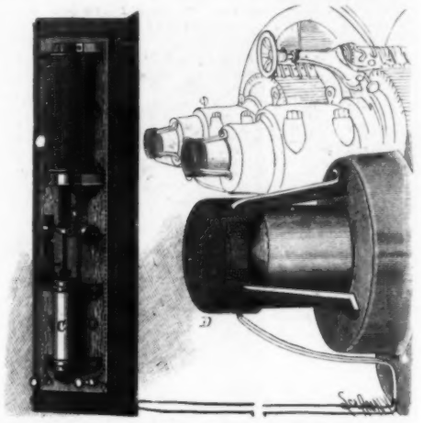
The map of Niagara, on page 20208, shows the various lands acquired by the companies, which they propose to rent out to such industrial concerns as wish to locate on their property and use the companies' power. Of these companies, the Niagara Falls Power Company alone owns 1,071 acres, while the Niagara Falls Hydraulic Power and Manufacturing Company owns 70 acres, as indicated on the map. The industries already established and using the electrical power are very numerous, and include the manufacture of paper, aluminium, carborundum, calcium carbide, peroxide of sodium, and other chemical industries. The street railway systems of Niagara, the Gorge railways and the railway to Buffalo, 22 miles distant, are operated by electricity generated from the Niagara waters, Buffalo alone taking 6,000 horse power for its city railroads and other power purposes. The present indications are that industries will move to Niagara instead of the electricity generated at the Falls being transmitted to any great distance for industrial purposes.

THE NIAGARA FALLS POWER PLANT—ABOVE THE FALLS.

WE have seen that at the present time the development of the water power of the upper Niagara River is carried out almost exclusively by two powerful companies, whose methods of utilizing the great hydraulic head presented by the Falls are so different, and include such elaborate and highly interesting plant, as to defy any adequate illustration or description in a single chapter. The present article will be devoted to the larger of the two plants, which is known as the Niagara Falls Power Plant and is situated on the American side at a distance of about a mile above the Falls.

The total fall available for power purposes between the river above the Upper Rapids and below the Falls is 216 feet. This has been utilized on two different plans. The Niagara Falls Power Company has placed its turbines at the bottom of a huge wheel-pit, 180 feet in depth, and excavated a great tunnel 7,000 feet in length, which acts as a tailrace to carry the water from the bottom of the pit to an outlet below the Falls. The available head in this case is 136 feet, measured from the surface of the company's feeder canal to the center of the turbines. The other company, known as the Niagara Falls Hydraulic Power and Manufacturing Company, conducts the water through the town of Niagara by an open canal, to a basin at the edge of the gorge below the Falls, from which it is carried by large penstocks down to turbines located in a power house at the base of the cliff, and a few feet above the level of the lower river. The available head in this case is 216 feet.

The water is led from the upper river to the power house of the Niagara Falls Power Company by a canal which is 12 feet deep, 250 feet wide, and 1,700 feet long, and is of sufficient capacity to supply water for the development of 100,000 horse power. The scheme as proposed and ultimately to be completed, calls for two power houses, one along each side of the canal, each containing generators capable of a total output of 50,000 horse power. At present only one power house has been built, as shown in our engravings on pages 20209 and 20215, with a designed capacity of 50,000 horse power, the whole of which is now installed. Below the floor of the house has been excavated a great rectangular wheel-pit 30 feet in width, 330 feet in length and 178 feet deep. Leading from the canal to the bottom of the pit are eight steel penstocks, each nearly 8 feet in diameter, which deliver water under a 136-foot head to ten 5,000-horse power turbines, which were designed by Messrs. Faesch & Piccard, of Geneva, Switzerland, and built by the I. P. Morris Company, of Philadelphia. These designs were chosen by the company from a number of competitive plans sent in



AUTOMATIC ATTACHMENT FOR SECURING EVEN WEAR ON COMMUTATORS AND JOURNALS.

by the most prominent hydraulic engineers of the world. In the accepted design the wheels are double Fourneyron horizontal turbines, one placed vertically over the other, the upper one being inverted. The circle of buckets of each wheel is divided into three horizontal divisions or stories. The water delivered by the penstock enters the space between the wheels, which is inclosed by a casting, constituting a sort of drum. About half of the water rises and, rushing out through the upper wheel, actuates it, while the rest of the water drives the lower wheel. The rising water, pressing upward against the disk of the upper turbine with the stress due to 136 feet of head, supports a variable portion of the weight of the shaft.

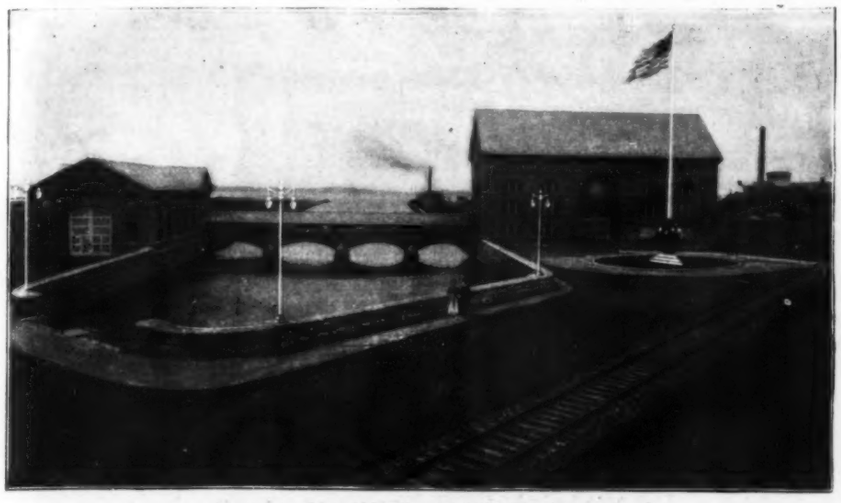
Each of the wheels includes two circular portions, one a fixed central guide-wheel carrying a peripheral circle of curved buckets through which the water escapes, its direction of escape being determined by the shape of the buckets. In the Niagara wheels these buckets are thirty-six in number. This guide-wheel with its circle of buckets is surrounded by a second circle of buckets arranged on the periphery of a disk, and this disk with its buckets rotates and constitutes the turbine proper. It has thirty-two buckets curved in the reverse sense referred to those of the stationary one. Each turbine system includes, there-

SECTIONAL VIEW OF THE 7,000-FOOT TAILRACE TUNNEL FROM THE POWER PLANT TO THE RIVER.
SHOWING THE OLD HIGHWAY SUSPENSION BRIDGE.

fore, the upper and the lower couple, each comprising a guide-wheel and turbine, marking the top and bottom of a cast iron drum, into which drum the penstock enters. From the smaller cut which shows in section the disposition of parts, it will be seen that the stationary or guide-wheels would close the ends of the drum, except that the upper guide-wheel is perforated, so that the water passes through it and presses upward against the rotating disk of the upper turbine. Were it not for these apertures, there would be no vertical water pressure upon either upper or lower turbine.

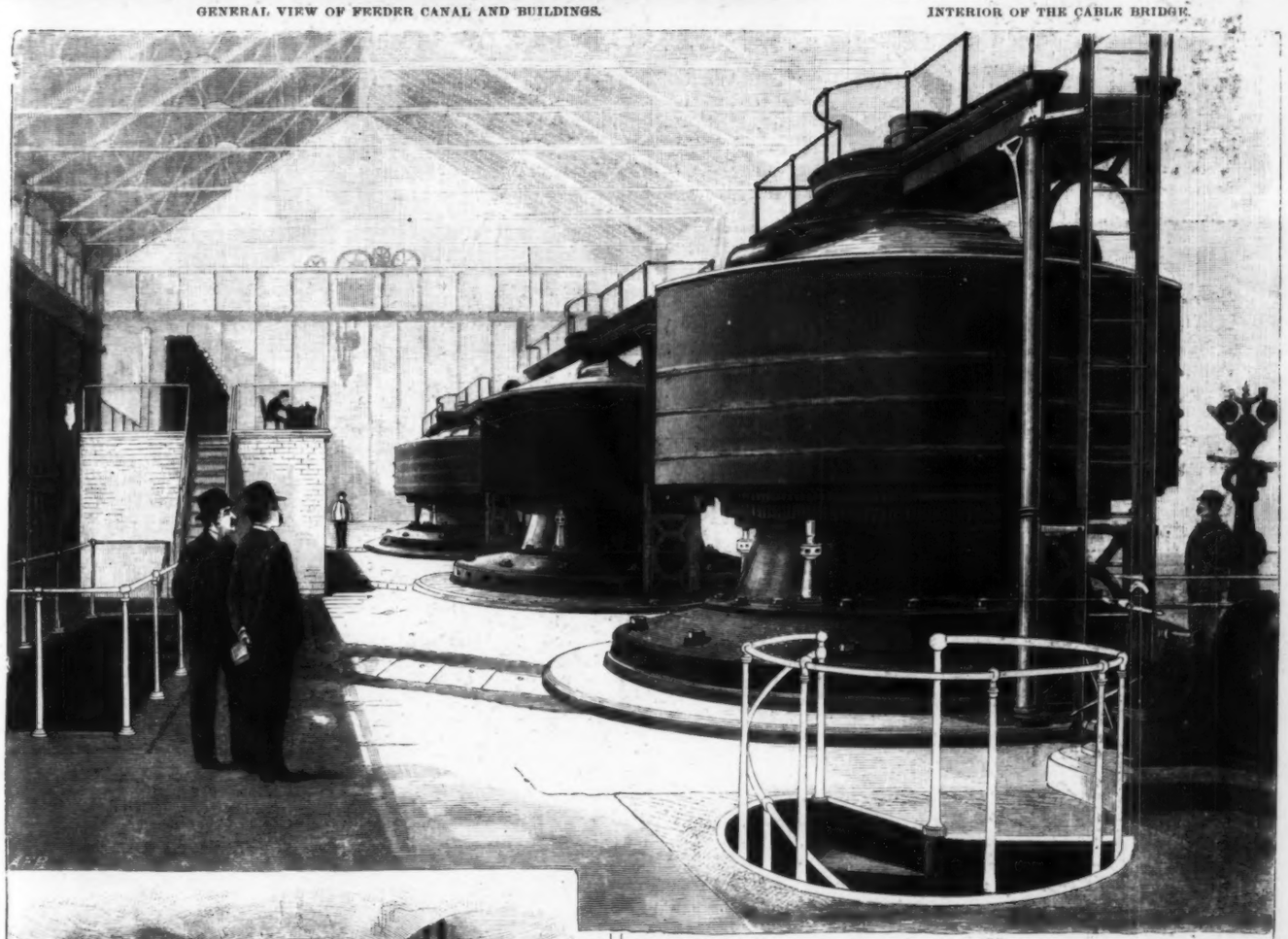
The small cut, page 20214, shows bars running diagonally up and down within the drum. These support the lower guide-wheel, which is subjected to the hydraulic head produced by the penstock. The relation of guide-wheel buckets to turbine buckets is shown in the small partial horizontal section in the same cut.

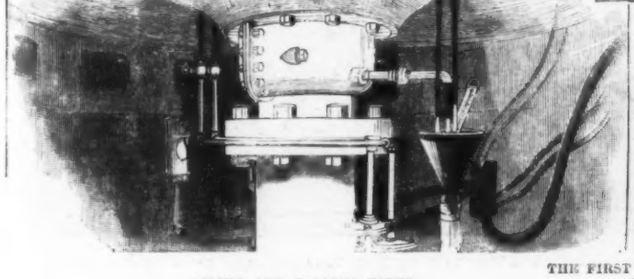
To regulate the speed of the wheel a governor is provided, which operates by raising and lowering a double annular speed-gate. This works up and down outside of the peripheries of the upper and lower turbines, cutting off the outlet for water as it rises, and giving a larger opening as it descends. In the sectional view the speed-gates are shown closing about two-thirds of the orifice, and on the deck above is seen the bearing for the speed-gate lever, which is shown by extending horizontally across the cut just above the floor level. The governor is guaranteed to keep the speed within two per cent. of the rate desired under ordinary con-



GENERAL VIEW OF FEEDER CANAL AND BUILDINGS.

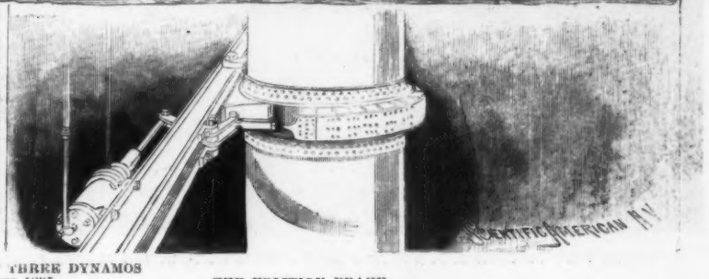
INTERIOR OF THE CABLE BRIDGE.





OILING AND COOLING PIPES.

THE FIRST THREE DYNAMOS IN 1895.



THE FRICTION BRAKE.

NIAGARA FALLS POWER PLANT.

ditions. Should the work be suddenly increased or diminished to an extent of twenty-five per cent., the governor will hold the speed variation down to four per cent.

A vertical thrust-bearing, similar, except that it is vertical, to that on the shaft of a screw propelled ship, is provided near the upper end of the shaft. This is necessary, because the varying inflow of water causes the pressure exerted by the shaft to vary. This pressure may even sometimes be negative or upward.

The wheels discharge at full load 480 cubic feet of water per second and utilize 136 feet of head, the wheels rotating 250 times per minute. When running at 250 revolutions per minute, each turbine develops 5,000 horse power. As will be seen from the engraving on page 20215, the wheel pit extends beneath the floor of the power house for its full length. From each turbine there rises a vertical shaft, which for the greater part of its length consists of a steel tube 38 inches in diameter with a shell ¾ inch in thickness. The upper portion of the shaft is of solid steel and is 11 inches in diameter, and at the top of this is carried the massive revolving field of a 5,000-horse power generator. The turbines are built upon a bottom platform of massive steel girders placed at a depth of 146 feet below the surface of the canal water; and three sets of girders which span the wheel-pit at regular intervals serve to carry steadying bearings for the vertical shaft.

The journals of the vertical shafts are kept constantly oiled by a never-ceasing flow of oil under a pressure due to its own head. This oil, after passing through the journals, is filtered and returned thereto. Water also circulates about the bearings to insure coolness, and the temperature of the liquid is constantly watched in order to ascertain when any heating occurs. One of the cuts on page 20217 shows the funnel through which

VIEW OF THE POWER HOUSE, LOOKING UP THE RIVER TOWARD THE FALLS.

INTERIOR VIEW OF 20,000-H. P. POWER PLANT, SHOWING HYDRAULIC VALVES AT FOOT 13-FOOT PENSTOCK READY FOR INSTALLATION OF THE NEW TURBINES.

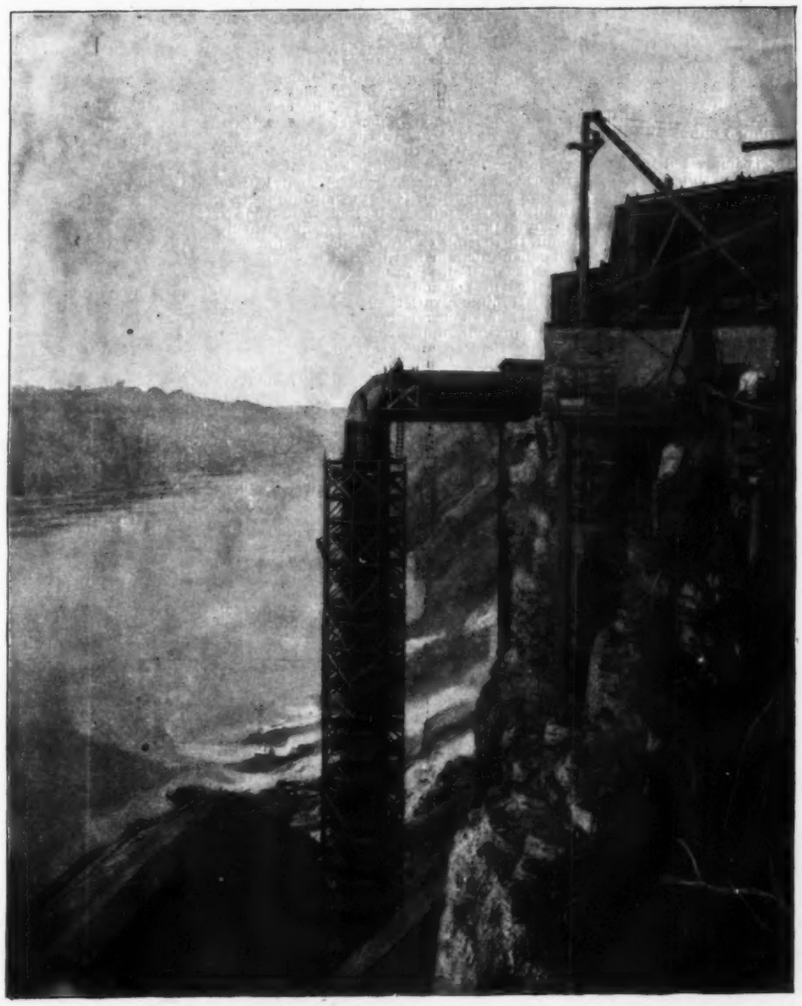
NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING PLANT.

the oil is delivered from the bearings, with a thermometer in it to show if any heating is taking place. The cut on the same page, illustrating a section of the steel shaft, also shows a friction brake used to stop the turbine. If the governing gate at the bottom, which is employed to shut off the water, be closed, a sufficient leakage occurs to keep the machine in rotation, and the brake is relied on to check the slow rotation due to such leakage.

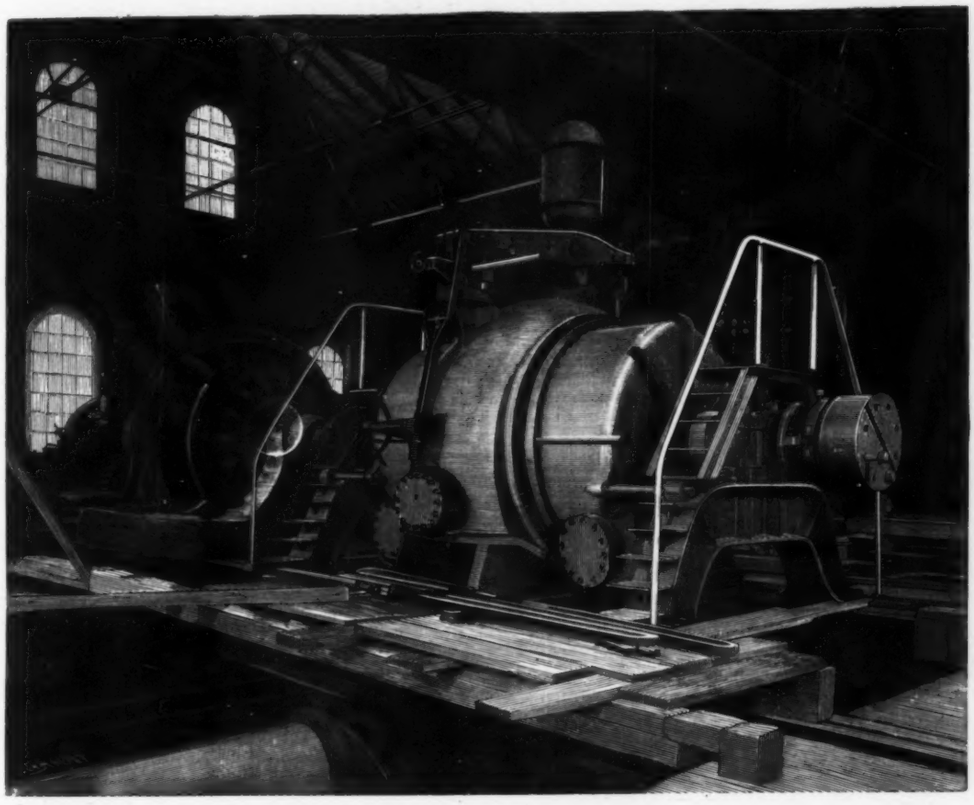
The great generators, of which there are ten, are placed vertically over the turbines, and rest partly upon the floor of the power house. The armature is stationary and is carried upon a massive conical casting, which is bolted to the arched roof of the wheel-pit, the top of which is level with the power house floor. The rotating field-ring is attached to the main shaft by means of a conical disk and rotates in a horizontal plane around the armature. The field-ring is a solid ring of nickel steel, 11 feet 7½ inches in outside diameter. It carries on its interior face 12 field poles, each with its winding weighing 2,800 pounds. The weight of each generator is 85 tons, the revolving field alone weighing about 40 tons.

Two systems are in use for governing the turbines. The first three are controlled by Faesch & Piccard hydraulic governors which act directly through a walking-beam upon the gates. The other seven turbines are controlled by electrical governors, which are so arranged that when the voltage falls, a magnetically operated clutch closes and serves to raise the gate. The pole-pieces of the field are supplied with 220-volt current supplied by the two generators shown in the foreground of lower cut, page 20214. The current is led to the rotating field by way of collecting rings at the top of the rotating disk, as shown in the diagram of the wiring, same page. These two exciters serve all of the main generators.

We draw particular attention to the photographic view of the interior of the power house (page 20215) as something quite unique in its way, for here we see represented the generation not only of the largest aggregate of electrical horse power, but the largest aggregate of any kind of horse power, now being developed under one roof and in one room anywhere in the world. The nearest approach to it is the engine room of the steamship "Campania," where 30,000 horse power is given out on the propeller shafts. It is true the great traction companies in New York are building and planning stations whose total output will be 70,000 to 100,000 horse power, but just now the splendid power house here represented has the greatest capacity of them all. The point of view of the photograph is the visitors' gallery, and one receives a vivid impression of the compactness and general convenience of electrical generating machinery when he bears in mind that each of those swiftly rotating machines, any of which could be placed within the walls of an ordinary cottage living room, is generating the enormous total of 5,000 horse power. Around the roof of each rotating field is arranged a series of hoods which serve to catch the air and cause a draught of cold air to pass through the generator. The hazy effect caused by the swift rotation of these hoods is noticeable in the illustration.



THE NEW 13-FOOT PENSTOCK, EXTENDING FROM THE GATE-HOUSE AT THE EDGE OF THE CLIFF TO THE POWER HOUSE, 110 FEET BELOW.



ERECTING THE FIRST OF THE 3,000-HORSE POWER JONVAL-GEYELIN TURBINES.

NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING PLANT.

The enormous two-phase 2,000-volt currents from the generators are led to a special switchboard, operated entirely by compressed air, on which a panel containing an ammeter, wattmeter, and voltmeter for each phase and a direct-current ammeter in the exciter circuit, is provided for each main generator. On the opposite side of the canal, from the power house, is a smaller building which contains the transformers, a covered passageway between the buildings serving to carry the mains. It is impossible within the limits of this article to describe in detail the various transformations of the current which are made to suit the needs of the various users. The diagram, page 20214, showing the wiring of the main generators, and also of the static and rotary transformers in which the current for the Niagara Falls railways is converted to direct current, will be of interest. The 2,200-volt two-phase current from the main generator is transformed by a static transformer in each phase to 440-volt current, and then led to a rotary transformer, where it is changed to 550-volt direct current for use on the local street railways. Of these the Niagara Falls and Suspension Bridge Company takes 250 horse power and the Buffalo and Niagara Falls Electric Railway 350 horse power. Perhaps the most interesting transmission is that of 6,000 horse power to Buffalo, twenty-six miles distant. The current for this purpose is stepped up from 2,200-volt two-phase to 11,000-volt three-phase in two huge static transformers located in the transformer building. These have been so arranged that by a change of connections the pressure may at any time be raised to 22,000 volts if it should be deemed advisable.

The company owns a continuous tract of land which includes two miles of river water front, and embraces over a thousand acres. Located upon this and other adjacent property are a large number of electro-chemical establishments which have been attracted to the locality. The names of some of these concerns and the horse power they are receiving from the Niagara Falls Power Company are as follows: Union Carbide Company, 15,000 horse power; Pittsburg Reduction Company, 3,600 horse power; Carborundum Company, 1,100 horse power; Mathieson Alkali Company, 2,000 horse power; Niagara Electro-Chemical Company (sodium), 650 horse power; Oldbury Electro-Chemical Company, 500 horse power; transmitted to Buffalo, 6,000 horse power. Altogether the company is supplying over 25,000 horse power, and it is

now under contract to supply 25,000 additional horse power for various purposes.

In addition to its sale of electrical power the company supplies 7,200 hydraulic horse power to the Niagara Falls Paper Company, whose large establishment is located near the power house. The water received from the power company is utilized by the paper company in turbines located in its own wheel-pit, which is connected with the main tunnel tailrace by a branch tailrace, 7 feet in diameter.

The visitor to this splendid plant is impressed with the great care that is taken to keep everything up to the highest state of efficiency, a care that extends to the smallest details. We present a cut of an attachment designed by the chief electrician, Mr. P. M. Lincoln, for securing an even wear on the commutators and also on the journals of the generators, converters, etc. It consists of an electro-magnet, *D*, which is held by means of three legs bolted to the frame of the generator, outside one end of the armature shaft, and a current interrupter which may be placed in any convenient corner of the building. The object of the device is to give the shaft a continuous reciprocating motion in the direction of its axis so as to prevent irregular wear in the brushes and journals. When the magnet, *D*, is excited the shaft is drawn out, and when it is demagnetized the shaft returns by the attraction of the field on the armature. When the coil, *A*, of the interrupter is excited it lifts its core, trips a small weighted lever, and breaks the contact at the carbon points, *B*, when the coil is demagnetized and the core and arm drop, the fall being retarded by a dashpot, *C*. The device is giving good results on the machines to which it has been attached.

We also present an illustration (page 20216) of the heaters designed by Mr. Lincoln for the dynamo room. They are made of two circular rolled iron plates which are about ¼-inch thick and twenty-four inches in diameter. Bolts hold these plates parallel, about 4 feet apart, one above the other. Each plate has about 28 holes in it, and the diameter of each hole is about ⅛ inch. In each of these holes is placed a porcelain insulator having a pretty large head, and through the insulators No. 6 iron wire is strung. There are 88 coils, and each coil is about 1⅝ inches in diameter, the distance between convolutions being about twice the diameter of the wire; at least, it is such that the resistance of the heaters, will take about 65 amperes at 440 volts, so that all five heaters, in series, will consume 2,200 volts at 65 ampheres.

It will be remembered that when the Niagara Falls Power Plant was first set in motion, there was a confident prediction by the press that before many years the energy of the Falls would be transmitted electrically to cities that were 100 miles or more distant. The statement was not generally indorsed by expert opinion, and it is significant that the tendency today is for the manufacturers to locate at the Falls rather than for the power of the Falls to be carried long distances to the consumer. Although the current, in the present state of the art, could probably be transmitted for 100 miles with a loss in transmission of less than 20 per cent., it would cost so much more to the consumer as to render the erection of works at Niagara a more profitable alternative.

Along the edge of the cliffs are the works of the Pittsburg Reduction Company (Aluminium) and the various factories supplied by the Niagara Falls Hydraulic Power and Manufacturing Plant. The Cascades are the tailrace waters from small factories which develop their own power under heads of 50 to 60 feet.

LOOKING DOWN STREAM FROM THE NIAGARA FALLS AND CLIFTON ARCH BRIDGE.

NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING PLANT

So much attention has been directed to the Niagara Falls Power Plant, with its present capacity of 50,000 horse power and actual output of between 30,000 and 40,000 horse power, that the public has not realized the size and rapidly growing importance of the Niagara Falls Hydraulic Power and Manufacturing Plant, which has at present a capacity of 20,000 horse power, and has an enlargement under way which will increase its total capacity to 32,500 horse power. The method of developing the hydraulic power differs widely from that of the Niagara Falls Power Plant, in which, it will be remembered, the water is led in from the river above the Falls by a short length of canal to the power house, and delivered through penstocks to a set of turbines which work under a head of 185 feet, the water being discharged through a 7,000-foot tunnel, with an outlet at the surface of the river below the Falls.

In the case of the Niagara Falls Hydraulic Power Plant, the water is taken from the river above the Falls by an open canal and led to a point about a mile below the Falls, where it passes through penstocks to turbines that are situated within a power house built close to the water's edge at the bottom of the Gorge, as shown in the accompanying illustrations. The advantage of the latter system is that the effective head is considerably increased, the loss of the head in the tunnel being 50 feet and in the canal only 2 feet. By suitably constructing the tailrace, and additional head of several feet is secured below the turbines, with the result that the total effective head of the hydraulic power plant is 216 feet. The total length of the surface canal is 4,400 feet, its present width at the entrance is 250 feet, and in 400 feet the width narrows down to 100 feet, at which width it continues for about one thousand yards; the remaining three thousand yards having a width of 70 feet. It finally discharges into a basin which is located about 300 feet back from the edge of the Gorge above the power house. The basin runs parallel with the edge of the cliff and is about 400 feet long by 70 feet wide. The company owns sufficient right of way to increase the width of the whole canal to 100 feet, if it desires to do so. For 40 feet of the present width of the canal the channel is 14 feet deep, and for the remaining 30 feet it is 8 feet deep. The work of widening the whole canal 100 feet and giving it a full depth of 14 feet is now in progress.

In addition to the different methods adopted in the two great power plants in the arrangement of the hydraulic plant, there is also a broad difference in their methods of generating and distributing the electrical power. In the Niagara Falls Power Plant the ten generators are identical in type and size, and the current produced is passed through a variety of transformers to convert it into the kind of current called for by the consumers. In the plant now under consideration, on the other hand, the generators are of several sizes and types, and each is designed with regard to the kind of current called for by the customers—a system which avoids the use of converters and transformers.

The power house is a substantial building of stone with a steel-truss roof. Water is led down to the power house by means of two penstocks, one of which is 8 feet and the other 13 feet in diameter. The original section of the building was completed in 1896, and its 8-foot penstock serves to convey water to four Leffel turbines, of 2,250 horse power each, which operate eight generators, six of which supply power to the lower works of the Pittsburg Reduction Company. Of the other two one furnishes power for the operation of the Niagara Falls and Lewiston Railway better known as the "Great Gorge" route, an illustration of which is given on page 20210. The other turbine furnishes power to several factories in the vicinity, and for the operation of the Lewiston and Youngstown Railroads. The original installation was so satisfactory that a large addition was immediately commenced, and the building was increased to the size shown in our illustrations. It now measures 100 feet by 120 feet. The addition to the plant consists of five wheels of the Jonval-Geyelin type, of from 2,300 to 3,000 horse power. Our illustrations show one of the new wheels in place. These wheels are fed by a new 13-foot penstock, which has a capacity of 12,500 horse power. It leaves the forebay with an elliptical bell mouth which measures about 20 feet by 11 feet. It is carried out horizontally from the cliff, supported on two heavy steel beams for a distance of 60 feet, and then drops vertically some 200 feet to the power house. For about 50 feet of its length beneath the power house floor it is 13 feet in diameter, and, after passing beneath two of the wheels, its diameter is gradually reduced until it tapers off into a cone 18 inches in diameter, and finally ends in an air-chamber, which is 4 feet in diameter by 15 feet in height. The object of the air-chamber is to cushion the vertical movement of such a great mass of water and prevent injurious shocks to the machinery. The steel used in the construction of the penstock varies from a thickness of ⅜ of an inch at the top to 1⅛ inches at the bottom.

Above the horizontal portion of the penstock beneath the floor are carried a series of five 60-inch hydraulic valves which are placed horizontally and serve to conduct the water from the penstock up to the five turbines which are placed immediately above them. These valves, with their supporting girders, are shown in the lower illustration of our first page. The water flows through the valves to the turbines and is admitted by a gate to the guide-wheels, and through them to the runners. From the sides of the turbine the discharge pipes project laterally and then downwardly to connect with draught tubes 22 feet 8 inches in length, the use of which make it possible to utilize in part the atmospheric pressure, and increase the effective head of the turbines accordingly. The turbine wheels are made of bronze, and they are located in the draught-tube casing, one on each side of the casing proper. The pair weighs 5,095 pounds. They are mounted upon a horizontal shaft and are directly connected on one side to a general electric generator, which supplies current to the new chlorate of potash plant of the National Electrolytic Company, located on the top of the cliff. A walking-beam, working over the main casing, operates the gate, which is connected to the beam by 2½-inch rods extending down through the glands into the casing. Above the walking-beam is an air cylinder 36 inches in height, with a diameter of 20½ inches. The turbine is controlled by a Lombard governor. It should be mentioned that there are thirty-four buckets on the runners, with a total area of 140·25 square inches. On the guide-wheel there are twenty buckets with a total area of 149·53 square inches. The General Electric Company's generator is shown in our illustration. It has fourteen poles and runs at 257 revolutions per minute, giving an output of 5,000 amperes at 17 volts. This represents a capacity of 875 kilowatts, or about 1,200 horse power. The current is carried to the chlorate of potash works on aluminium cables, the lower part of which is made in bar form, and the upper part in the form of well insulated cables.

The dynamo for the Buffalo and Niagara Falls Electric Light and Power Company is of 700 kilowatts output capacity at 2,200 volts pressure. It is single-phase and of high frequency, and in this differs from other recent alternators of large size, which are polyphase and have a frequency of not much over 60 cycles. It has 60 poles, giving a frequency of 125 cycles per second at the normal speed of 250 revolutions per minute.

There has recently been added to the equipment a 200-kilowatt 135-volt shunt-wound general electric generator, which supplies current to the Alloy Smelting Company, who are manufacturing chromium by a secret process. This generator is driven by one of the turbines on the 8-foot penstock. Two horizontal turbines of 2,300 horse power capacity each have also lately been installed on the new penstock. Like the one illustrated they are of the improved Jonval-Geyelin type. The generators driven by these turbines are rated at 750 kilowatts each, delivering 2,500 amperes at 300 volts, and the current will be taken by the Pittsburg Reduction Company, who are realizing an increased demand for aluminium for use in place of copper as electrical conductors.

Two additional 3,000-horse power turbines are now being built for the two vacant outlets of the 13 foot penstock. They will drive a 5,000-ampere generator which will supply current to the National Electrolytic Company, and three 1,000-kilowatt machines for delivering current to the Acker Process Company.

The completion of the five Jonval-Geyelin turbines will raise the horse power at this station to over 22,000, but it is intended to build another 13-foot penstock and increase the total horse power of the plant to 34,500, which will be the maximum that can be developed from the present upper basin. Ultimately, however, it is intended to extend the basin along the cliff beyond the present factories of the small users of the company's water power, and carry down other penstocks to a new power house at the edge of the river. The company has sufficient room to install a plant of 100,000 horse power, which is well within their grant of 125,000 horse power. The present capacity of the canal is about 40,000 horse power, but the company has a force of dredges which are continually at work enlarging and deepening. The whole of this most interesting plant is in charge of Mr. W. C. Johnson, the hydraulic engineer of the company.

Visitors to Niagara will have noticed the cascades of water which fall from the side of the cliff in varying quantities in the immediate neighborhood of the company's power house. These streams are the tailraces of the various smaller factories which are built at the edge of the cliff, and take water from the company's basin behind them. The turbines operate under heads of from 60 to 100 feet. In some cases they are sunk in wheel-pits and discharge through tunnels, while in others a cutting is made through the face of the cliff. The total hydraulic power thus developed is about 7,500.

This brings us to the close of a subject which we have treated at considerable length because we believe that there is a great demand for complete information upon a matter of such importance as the utilization of the energy of the Falls.

Isolated statements of work done in this or that establishment at Niagara Falls have been published from time to time, but these are not sufficient to give such a comprehensive view of the subject as we have endeavored to set forth in the present issue. While the work of developing this great source of hydraulic power has not gone forward with the rapidity which was popularly expected, it must at least be admitted that what has been done has been carried out on conservative lines and with such a measure of success as promises well for the future development of Niagara Falls as an industrial center.

TRADE NOTES AND RECEIPTS.

Bleaching Agent.—Aluminium hypochloride, or Wilson's bleaching liquid, is produced by adding to a clear solution of lime chloride a solution of aluminium sulphate (alumina, alum) in a slow-jet as long as a precipitate keeps forming. By mutual decomposition aluminium chloride results, which remains in solution, and lime sulphate (gypsum) which separates out in the form of an insoluble salt.—Farben Zeitung.

Liquid Bronze.—A color which looks like bronze while containing no metal, but only organic substances is prepared as follows: Dissolve 10 parts of aniline red, and 5 parts of aniline purple in 100 parts of alcohol (95 degree) at moderate heat in the water bath. After complete dissolution, add 5 parts of benzoic acid and boil the whole for 5 to 10 minutes in an earthen vessel, until the color, greenish till then, changes into pale bronze brown.—Papier Zeitung.

Washing Powder.—The fundamental material is generally sodium carbonate or even caustic soda. The washing powders, as a rule, consist of:

Calcined soda, 80 parts; Glauber's salt, 10 parts; ordinary cooking salt, 5 parts; water, 5 parts, equal 100 parts.

Calcined soda, 90 parts; borax, 5 parts; water, 5 parts, equal 100 parts.

Calcined soda, 91 parts; ammonium chloride, 6 parts; soap powder, 2 parts; water, 1 part, equal 100 parts.

Caustic soda, 40 parts; soda powder, 30 parts; starch, 10 parts; water, 20 parts, equal 100 parts.

Calcined soda, 9 parts; sodium hyposulphite, 5 parts; borax, 2 parts; water, 3 parts, equal 100 parts.

Ammonia soda, 48 parts; potash (75 to 80 per cent.) 6 parts; caustic soda (70 per cent.), 8½ parts; soluble soda glass, 36 parts; potassium permanganate, 1 part; thyme oil, ⅛ part, equal 100 parts.—Farben Zeitung.

Substitute for Elaine for Oiling Woolen Yarn.—A good substitute for elaine is obtained by boiling 4 kilos of carragheen moss and 4 kilos of ammonia soda (0·98 per cent.) for 3 hours in a large kettle holding 500 liters with 250 kilos of water. The soda is only added after the carragheen moss has boiled down completely. Boil ½ hour after admixture of the soda, stir well, and slowly add 2 kilos of flea-bane seed, at the same time pouring in some cold water.

After the kettle has been filled three-fourths with water, boil about another 1½ hours, pass the extract through a fine sieve into a stirring vat and add cotton-seed oil, 25 kilos; olive oil, 12·5 kilos; spirit of sal-ammoniac (0·960), 12·5 kilos, stirring for some time.

Next day stir in 25 kilos of elaine sapon (saponified elaine) and 13 kilos of mineral oil (0·885 specific gravity) free from fluorescence and odor.

The emulsion thus obtained keeps well, dissolves perfectly in lukewarm water, and is excellently adapted for greasing wool.—Seifensieder Zeitung.

Preservation of Fishing Nets.—The Allgemeine Fischereizeitung publishes the following receipts for the preservation of fishing nets which are, of course, also applicable to ropes, etc., in contact with water. Some have been subjected to a long test by the Drontheimer Fischerie Gesellschaft. 1. For 40 kilos of cord, hemp, or cotton, 3 kilos of cutch, 1 kilo of blue vitriol, ½ kilo of potassium chromate, and 2½ kilos of wood tar are required. The cutch is boiled with 150 liters of water until dissolved, and then the blue vitriol is added. Next, the net is entered and the tar added. The whole should be stirred well, and the cordage must boil 5 to 8 minutes. Now take out the netting, lay it in another vessel, cover up well, and leave alone for 12 hours. After that it is dried well, spread out in a clean place, and coated with linseed oil. Not before 6 hours have elapsed should it be folded together and put into the water. The treatment with linseed oil may be omitted. 2. Dissolve 1 kilo of blue vitriol in water. Immerse the net, which must be perfectly dry, in the solution for 24 to 28 hours. This treatment must be repeated every three or four weeks.

Purification and Preservation of Chloroform.—The Journal de Chimie et Pharmacie gives the following useful directions for the purification and keeping of chloroform:

The purification, according to Mason, is accomplished as follows:

1. By washing with distilled water.
2. By a 2 to 3 days' treatment with sulphuric acid (2·5 per cent.).
3. By treating 3 to 4 days with soda lye (3 per cent.) of 1·33 specific gravity.
4. By washing with distilled water.
5. By drying over fused calcium chloride, shaking 2 to 3 hours, with addition of 2·5 per cent. of clove oil.
6. By distillation and absorption in previously weighed measuring vessels containing $\frac{1}{1000}$ part by weight of the chloroform-alcohol to be absorbed.

Operations 1 to 4 are conducted in two glass vessels, which are turned and agitated continually in a special apparatus. The sulphuric acid, when a perceptible coloring appears, is changed two to three times, the purification of 40 kilos requiring 8 to 10 days.

For keeping purposes clove oil has proved to be an excellent preservative, since dry chloroform mixed with the oil, exposed to sunlight, furnishes a faultless distillate, which does not become cloudy down to —15° C. The oil is said to saponify, traces of glycerine being found.

The admixture of alcohol appears to be justified by the fact that the Pharmacie Centrale is keeping, since 1889, a chloroform containing $\frac{1}{1000}$ of alcohol, which, exposed to the light, in a glass stopper vessel, has kept well.

The chloroform is best kept in glasses with ground stoppers. But as these stoppers do not prevent the chloroform from evaporating, Allain recommends the following lute with chrome gelatine, which effects a perfect exclusion of air:

a. Gelatine	100
Distilled water	300
Glycerine	10
b. Potassium bichromate	20
Distilled water	200

Both mixtures are dissolved separately, and, for use, 40 grammes of solution *a* are mixed with 20 of *b*, and heated to 55° to 60° C.

SELECTED FORMULÆ.

A copying ink that will copy legibly on tissue paper without water or a copying press can be made by taking 10 ounces nigrosine, C. P. fine, glucose A, 1½ ounce, hot water 1¾ pints, and glycerine 1¼ ounce. The nigrosine is to be dissolved by trituration in the hot water, the other ingredients to be then added and the mixture strained through a piece of silk. If too thick to flow from the pen readily it can be diluted with water.

Ammonia for Household Use.—

1. Yellow soap	10 grains.
Borax	1 drachm.
Lavender water	20 minims.
Stronger ammonia water	6 ounces.
Water enough to make	20 "

Dissolve the soap and borax in 5 ounces of boiling water; when cold add the lavender water and ammonia, and make up to a pint with water.

2. Methylated spirit	1 gallon.
Soft water	1 "
Stronger ammonia water	1 "
3. Ammonia water	5 pints.
Distilled water	5 "
Soap	100 grains.
Olive oil	5 drachms.

Cut the soap in shavings, boil with the oil and water, cool, add the ammonia water, and bottle. For use in laundries, baths and general household purposes, add one tablespoonful to one gallon of water.—Pharmaceutical Era.

Liquid Bronze.—For the production of liquid bronze, acid-free varnish should be used, as bronze ground with ordinary varnish will form verdigris. For the de-acidification of damar-resin, pour 1,000 grammes of petroleum-benzine over 350 grammes of finely ground damar-resin, and dissolve by repeated shaking. Next, add to the solution 250 grammes of a 10 per cent. aqueous solution of caustic soda and shake up well for ten minutes. After standing for a short while, two strata will have formed, the upper one consisting of benzine-resin solution and the lower, aqueous one, containing the resinic acid dissolved as soda salts. Pour off the benzine layers and agitate again assiduously with 250 grammes of the 10 per cent. caustic soda solution. Now set aside for a complete classification and separation of the two liquids. The damar solution siphoned off will be perfectly free from acid. To obtain gold bronze varnish, add to the de-acidified damar solution about 250 grammes of bronze or brocade per liter.

Or else carefully mix 100 grammes of finely ground damar-resin with 30 grammes of calcined soda and heat to fusion, in which state it is maintained two or three hours with frequent stirring. Now let cool, grind the turbid mass obtained and pour 9 c c m., of coal benzine or petroleum benzine over it in a flask. By repeated shaking of the flask the soluble portion of the molten mass is dissolved; filter after allowing to settle; into the filtrate put 300 to 400 grammes of bronze powder of any desired shade, the brocades being especially well adapted for this purpose. If the metallic powder remains distributed over the mass for a long time, it is of the right consistency. If it deposits quickly, it is too thin and a part of the solvent must be evaporated before stirring in the bronze powder.—Oil, Paint and Drug Reporter, from the Zeitung für Blechindustrie.

Solid Cleansing Compound.—The basis of most of the solid grease eradicators is benzine and the simplest form is a benzine jelley made by agitating, say, 3 ounces of tincture of quillaia (soap bark) with enough benzine to make 16 fluid ounces. Benzine may also be solidified by the use of a soap with addition of an excess of alkali. Formulas in which soaps are used in this way follow:

1. Cocoanut oil soap	2 av. oz.
Ammonia water	3 fl. oz.
Solution of potassium	1½ " "
Water, enough to make	12 " "

Dissolve the soap with the aid of heat in 4 fluid ounces of water, add the ammonia and potassa and the remainder of the water.

If the benzine is added in small portions, and thoroughly agitated, 2½ fluid ounces of the above will be found sufficient to solidify 32 fluid ounces of benzine.

2. Castile soap, white	3½ av. oz.
Water, boiling	3½ fl. oz.
Water of ammonia	5 fl. dr.
Benzine, enough to make	16 fl. oz.

Dissolve the soap in the water, and when cold, add the other ingredients.—American Druggist.

Liquid for Etching or Writing on Glass.—

1. Sodium fluoride	36 parts
Potassium sulphate	7 "
Distilled water	500 "

Mix.

2. Zinc chloride	14 parts
Distilled water	500 "
Acid hydro-chloric	65 "

Mix.

Dissolve in separate vessels and mix the solutions only when required for use. Write with a clean quill pen, being careful not to get too much of the liquid on the pen, as there is danger of blotting. The writing or etching, appears in the course of a half hour.—National Druggist.

Moth Essence.—According to the Nueste Erfindungen und Erfahrungen, the following makes a splendid moth preventer:

Spanish pepper	100 parts
Turpentine oil	50 "
Camphor	25 "
Clove oil	10 "
Alcohol 96 per cent	900 "

Cut the Spanish pepper into little bits, and pour over them the alcohol and oil of turpentine. Let stand two or three days, then decant, and press out. To the liquid thus obtained add the camphor and clove oil, let stand a few days, then filter and fill into suitable bottles. To use, imbibe bits of bibulous paper in the liquid and put them in the folds of clothing to be protected.—National Druggist.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Fruit in Germany.—Consul General Guenther, of Frankfort, on December 13, 1899, writes that local newspapers publish the following from Hamburg:

The ever-increasing import of American fruits has greatly increased the consumption of fruits in Hamburg and vicinity. The prices for fruits which formerly, with the exception of a few kinds, were high, have been somewhat reduced by these importations, so that it is now possible for the middle classes to become consumers.

Under these circumstances, excitement has arisen because the Prussian ministry has now instituted an inquiry as to whether a protective duty should be levied on American apples. The association of Hamburg dealers in fruits and vegetables has protested vigorously. There is no reason to doubt that the Hamburg Chamber of Commerce will take the same stand and do everything to prevent the carrying out of such a plan.

Consul Washington, of Valencia, under date of January 3, 1900, reports the receipt of a letter from Mr. José Fernandez y Carreras, of that city, offering for sale two reputed Rubens, a Madonna and child, and a Magdalen; also a piece of antique silk tapestry 4 yards long by 1·8 yards wide. Photographs of the pictures and tapestry accompany the report, and are filed in the Bureau of Foreign Commerce for examination by interested parties.

Water Electric Power in Morrisburg, Canada.—Consul Hamilton, under date of December 22, 1899, reports that, after many futile efforts, the mayor and the town council of Morrisburg have obtained a lease from the government for twenty-five years of 250 horse water power, to be used for the development of electric power for manufacturing industries, furnishing light for streets, houses, etc. This development will cost about $30,000, as per estimate of hydraulic engineer in charge. This power can and will be materially increased as necessities may require. The council is using every means to get manufacturers to establish here, offering free water, light taxes, and a bonus.

Trade Conditions in Russia.—Under date of January 4, 1900, Consul Heenan writes from Odessa:

Patience and long credits are absolutely essential to do business in Russia. Russia, in a business way, is practically the great unknown. I would like to utter a word of warning to Americans attempting to do an indiscriminate business in this country. Much is published about the great opportunities in this country, but very little is told about the difficulties, losses, and embarrassments which are always met with by those who fail to take the proper precautions. In case of failure, the home creditors are usually paid, but the foreign ones are not. The fact that we have furnished the Russian government with millions of dollars worth of various goods and were paid for the same is gratifying. The Russian government always pays, but discrimination should be used in dealing with the business element generally.

Canadian Butter in England.—Consul Brush, of Niagara Falls, under date of January 20, 1900, sends the following:

The growth in the exports of Canadian butter to Great Britain is attracting general attention. In 1897, the average exports of butter from Canada to the English market were 3,500 cwts., (392,000 pounds) per month; in 1898, the average was 5,500 cwts. (616,000 pounds) per month; and during the first eight months of 1899, the average exceeded 14,500 cwts. per month. In August, 1899, the tremendous total was recorded of 60,957 cwts. (1,624,000 pounds) or 52,387 pounds of butter per day. The butter is prepared especially for export, brings a high price, and the demand for it seems almost unlimited. The Minister of Agriculture has been especially active in promoting the sales of Canadian butter and cheese throughout Great Britain. The results of two years' work show possibilities that are worthy the earnest attention of United States shippers.

Demand for Fish Scales in France.—Consul Covert writes from Lyons, under date of December 27, 1899:

A call has been made at this consulate for fish scales, to be used in the manufacture of artificial pearls and other ornaments by the recently discovered method of a French chemist. The supply is much less than the demand, and it is said that large quantities will be used and a good price paid for them. The scales should be sprinkled with salt as soon as they are removed from the fish and packed in tin cans. Any specimens sent to this consulate will receive careful examination, and the results, with any suggestions that may be made and particulars of prices offered, will be duly reported. It is believed here that the sale of these scales may result in establishing an important business in an article that now has no commercial value.

French Wine Crop of 1899: Correction.—Consul Covert, of Lyons, under date December 28, 1899, writes as follows:

In my report upon the French wine crop of 1899, published in Advance Sheets of Consular Reports No. 614 (December 28, 1899), the annual yield, 47,907,000 hectoliters, as quoted from the Journal Officiel, does not include the product of Corsica, which amounted to 250,000 hectoliters (6,604,250 gallons), or of Algeria, which was 4,648,000 hectoliters (122,786,216 gallons).

Disposal of Trade Catalogues at Vancouver.—Consul Dudley writes from Vancouver, January, 1900, as follows:

I have received a large number of catalogues and price lists from manufacturers and merchants in the United States. So far as I have been able, I have brought them to the attention of dealers in this vicinity. Some time ago, the idea occurred to me of displaying these books in the rooms of the board of trade. I therefore wrote the president of the board, offering to send the catalogues and price lists to the rooms of the board. I have received a letter from the secretary, in which he informs me that the board has voted to receive the catalogues and have them arranged so that the members can easily consult them. By this arrangement, all the prominent merchants in this vicin-

ity are in a position to see and consult these catalogues without the trouble of visiting this office for that special purpose. I hope this arrangement will result in an increase of the sales of American goods in this market.

Argentine Tariff for 1900.—The secretary of legation at Buenos Ayres, Mr. Francois S. Jones, telegraphs, under date of February 3, that in the tariff just passed by Congress there are no changes of importance except a reduction in the duty on typewriters from 25 per cent. to 5 per cent. ad valorem. The aforo, or custom house valuation, has been slightly raised on wheel plows and white pine, and reduced on enameled ironware and yellow pine. The aforo takes effect February 1. Kerosene is taxed the same as last year.

Consular Invoices Required by Brazil.—Under date of Bahia, December 16, 1898, Consul Furniss says:

In accordance with a Brazilian law of November 21, 1899—

"Exporters of merchandise from foreign ports to any Brazilian port must, after January 1, 1900, present the following documents at the Brazilian consulate: Proof of the port of origin, with two invoices to be duly certified by the consul, one of which will be returned to the shipper, to be forwarded with the goods, the other being retained by the consul, who in turn will forward it to the statistical department."

As can be seen, this virtually puts into effect the same regulations relative to invoices as prevail in our service. Invoices have not heretofore been required by Brazil.

Silk-Spinning Spiders in Venezuela.—Consul Plumacher, of Maracaibo, under date of December, 26, 1899, report that large silk-spinning spiders are found in the palm trees of Venezuela. Some produce white, some yellow, silk. The consul understands that the silk has been made into handkerchiefs. A copy of the report, together with a specimen of silk which accompanied it, was referred to the Department of Agriculture. Under date of January 27, 1900, the entomologist says that silk produced in this way cannot be made valuable commercially, because of the troublesome necessity of keeping the spiders separated to prevent their devouring each other. Their food being insects, this also involves considerable labor in supplying them. Attempts to utilize the silk of a Madagascar spider of the same species some years ago resulted in the discovery that the product was more expensive than ordinary silk.

German Commercial Museum.—An Oriental commercial museum has lately been opened in Berlin for the double purpose of establishing a permanent exposition of samples, on the plan of the Philadelphia Commercial Museum, and of acting as a chamber of commerce in facilitating trade between Germany and the Orient, says Vice-Consul General S. W. Hanauer, of Frankfort. This sample warehouse brings to the view of the German public the agricultural and industrial productions of eastern countries.

A complete library and reading room, containing literature and newspapers from the Orient, are at the disposal of merchants, manufacturers, and all others interested. A bureau of information is also attached, the object of which is to give instruction and reliable information about business firms, and the peculiar conditions of various lines of trade in the Orient. The work of this bureau is to constantly watch the markets of the different eastern countries, and gather and study the confidential reports which are sent in by its numerous staff of merchants and paid correspondents located in those countries.

This new enterprize publishes a paper called Oriental Correspondence, which transmits the latest and most important news from the bureau's correspondents. Another publication, issued periodically, called The Orient, has for object to foster trade relations and bring about closer connections with the people and governments of Oriental sections. This review is in charge of a gentleman who for many years past has been attached to the Turkish embassy at Berlin as dragoman. He is universally admitted to be one of the best experts on eastern affairs and trade conditions.

Great expectations are entertained by German governmental and commercial circles as to the benefits which will accrue to German export trade from the workings of this museum. The Sultan of Turkey has shown his sympathy by ordering the imperial Ottoman factories to send a full line of samples of their products to the museum. The Prince of Bulgaria has done the same, and the governments of Roumania, Greece, and Servia will follow their example.

Melons in Italy.—Consul Hayden, of Castellamare di Stabia, on December 12, 1899, says:

In this portion of Italy, muskmelons at best are very inferior to the American fruit, lacking the sweet flavor of our melon. Strange to say, however, this same melon when reserved for consumption in winter is very acceptable. A custom exists here of pulling the melon from the vine while green, and hanging it up in the open air until winter, when it is eaten. The melon becomes not only far superior to the ripe fruit of summer, but quite equal to the American product. If this system could be adopted in the United States, it might prove of value.

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No. 653. February 13.—Notes from Northern Brazil—Duties on Sulphuric Ether in the Netherlands—Liquidation of Debt of Salvador—*Melons in Italy.

No. 654. February 14.—International Marine Congress at Paris *Scarcity of Coal in Italy—*Railway in Shantung.

No. 655. February 15.—Rubber Industry of Sierra Leone—*German Enterprise in Italy—*Lighting of Indian Cities.

No. 656. February 16.—*New Spanish Tariff—German Commerce in 1899—*German Commercial Museum—*Agricultural Implements in India.

No. 657. February 17.—Tariff in Paraguay—*Silk-Spinning Spiders in Venezuela—British Imports and Exports of Gold and Silver.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

NEW BOOKS

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Birds. A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from Richard Lydecker, Charles S. Roy, and Robert W. Shufeldt. 4to, cloth, illustrated, 1,088 pages. London $5 00

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